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THE MARINE ECOLOGY OF LANCASTER SOUND AND ADJACENT
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The Marine Ecology of Lancaster Sound and Adjacent Waters: An Annotated Bibliography

Robert A. Buchanan
Wayne E. Renaud
LGL Limited
Environmental Research Associates
Toronto, Ontario

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Cette publication peut aussi être obtenue en français.

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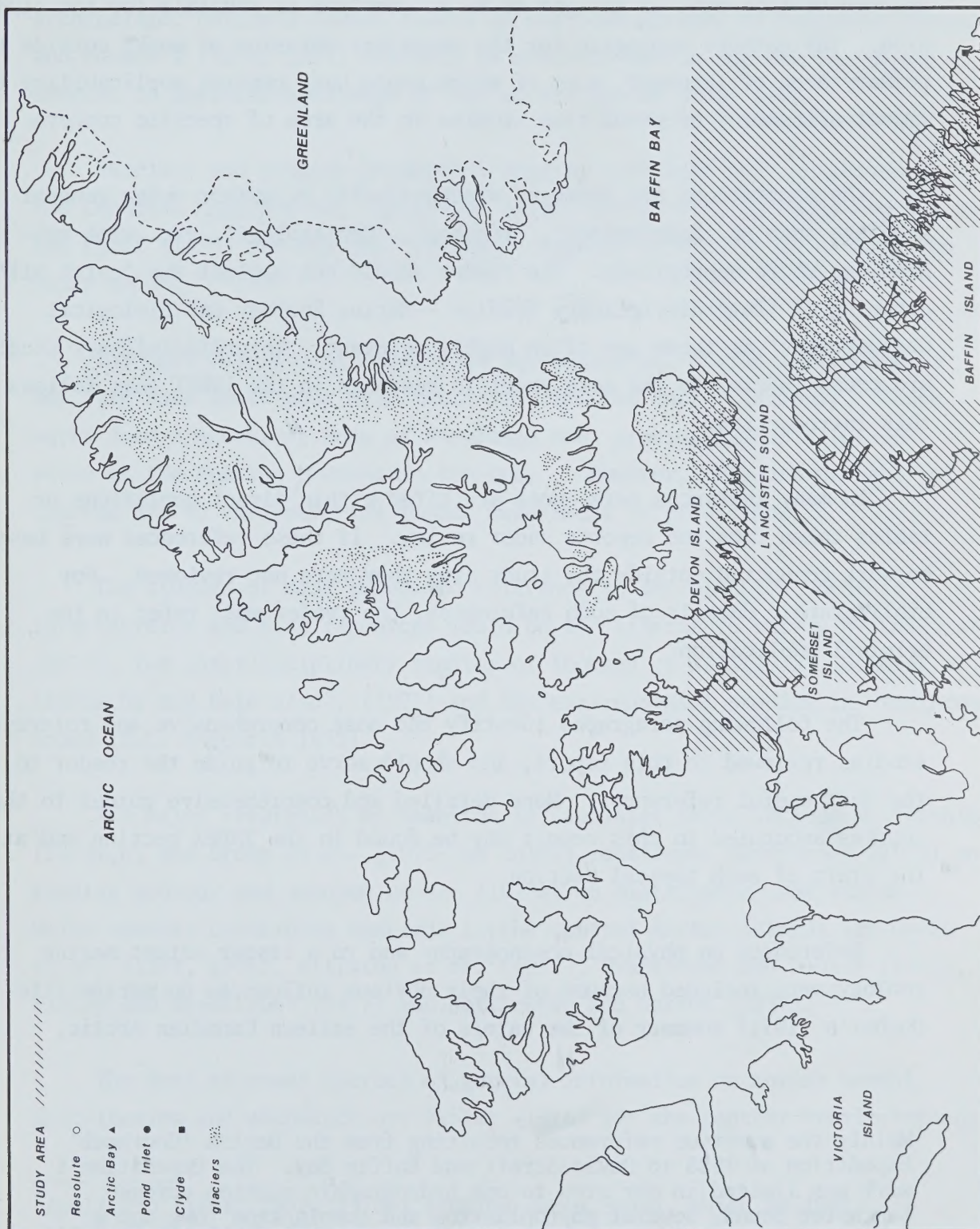
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INTRODUCTION

This selective annotated bibliography was prepared for the Institute of Ocean Sciences, Environment Canada. It is intended to serve as a guide to and a source of information that will aid in assessing or predicting the impact of offshore exploratory drilling in the Canadian eastern and central High Arctic. Because the annotations were developed for this specific purpose, they concentrate on those aspects of reports that are of potential relevance to the marine biological resources of the selected area. No attempt has been made to interpret raw data in the reports or to actually assess or predict possible environmental impact. However, critical evaluations and comparisons of methods, results and conclusions have been made in many cases.

The bibliography is the result of a literature search in the LGL Ltd. library and the McGill University libraries, particularly the Marine Sciences Centre holdings. Identification of the most recent sources of information was aided by telephone interviews with numerous government scientists engaged in Arctic research.

The geographic limits of this review encompassed the waters of north-western Baffin Bay (from Lancaster Sound on the north to Clyde River on the south), Lancaster Sound, Eclipse Sound, Admiralty Inlet (including Strathcona Sound), Prince Regent Inlet, Wellington Channel and Barrow Strait (see following map). Studies conducted outside the defined study area are not included in this bibliography, with the exceptions of several studies that were considered to be particularly relevant. Approximately 500 references were surveyed and about 200 are reviewed here. The somewhat arbitrary boundaries necessitated the elimination of major works conducted in other areas of the Canadian Arctic such as Frobisher Bay and the Beaufort Sea. In addition, no systematic attempt was made to review pre-1900 literature or the Russian literature.



Many of the Danish publications pertaining to Baffin Bay¹ have been included and the bibliography is thought to be as complete as possible for the study area. The authors apologize for the necessary omission of works outside the primary area of interest, some of which could have general applicability to impact assessment or prediction studies in the area of specific concern.

The annotations are arranged alphabetically by author under general headings such as 'Zooplankton', 'Benthos', 'Ornithology', etc. with sub-headings where appropriate. The reader should not neglect the 'catch all' grouping of 'Interdisciplinary Studies - Marine Ecology and Biological Oceanography' as these are often highly relevant. Interdisciplinary studies are cross-indexed to the more specific headings in the INDEX that follows this Introduction.

In many instances references are cited within direct quotations or tables taken from the reports under review. If these references were based on work conducted outside the study area they were not reviewed. For bibliographic details of such references, the reader must refer to the original publication.

The following paragraphs identify the most comprehensive and relevant studies reviewed in this report, and should serve to guide the reader to the most useful references. More detailed and comprehensive guides to the sources annotated in this report may be found in the INDEX section and at the start of each topical section.

References on physical oceanography and to a lesser extent marine geology were included because of their obvious influences on marine life. Dunbar's (1951) summary of the waters of the eastern Canadian Arctic,

¹Mainly the numerous references resulting from the Danish 'Godthaab' Expedition of 1928 to Davis Strait and Baffin Bay. The Expedition's work was limited in our area to one hydrographic section across Lancaster Sound, several phytoplankton and zooplankton tows and a few benthic collections.

Bailey's (1957) summary of the oceanographic features of the Canadian Archipelago, Collin's (1962) thesis on the oceanography of Lancaster Sound, and Muench's (1971, 1972) research in northern Baffin Bay are the major sources of physical knowledge of the waters in our study area.

Nutrient and primary production studies have been much neglected in the Canadian High Arctic. Apollonio (1956, 1965, 1973, 1976a,b) and Welch and Kalff (1975) are the only available reports of studies in or near the study area².

The vast majority of studies on phytoplankton, marine invertebrates and fish have dealt only with their distribution and/or taxonomy. These works form a necessary base of knowledge and provide valuable information on the species present in the area. However, they are probably of limited use to environmental impact assessment or prediction.

The studies of most immediate relevance to the plankton, benthic invertebrates and fish resources would be the literature survey by Lalli *et al.* (1973), the interdisciplinary studies of Thomson *et al.* (1975), Sekerak *et al.* (1976a,b) and Bain *et al.* (1977) and the environmental studies in Strathcona Sound (B.C. Research 1975).

The major references on seabirds in Lancaster Sound include Nettleship (1974a,b) and Brown *et al.* (1975) on colony locations, Bradstreet (1976) on feeding ecology and Johnson *et al.* (1976a) on distribution and status. Major sources concerning seabirds in the central Arctic Islands are Davis *et al.* (1974, 1975), Alliston *et al.* (1976), Bradstreet and Finley (1977), Finley and Bradstreet (1977) and Nettleship and Gaston (1977).

The most relevant sources of general information on marine mammal distribution and abundance are Finley (1976) for the central Arctic Islands,

²Apollonio (1965, 1973, 1976b) studied Jones Sound, which is just north of the study area.

R.R.C.S. (1977) and Johnson *et al.* (1976b) for eastern Lancaster Sound, and Tuck (1957) and Greendale and Brousseau-Greendale (1977) for Bylot Island. There are, in addition, numerous relevant reports on certain aspects of the distribution and life history of particular species or groups of marine mammals.

The following two reports are in preparation and were not available for review. The studies were conducted in our area of concern and should, when available, be of direct relevance to impact prediction.

Fallis, B.W. in prep. An interim report on marine and freshwater resources in the vicinity of the Nanisivik Mine, Strathcona Sound, Northwest Territories. Fish. Mar. Serv. Tech. Rept.

Stephansson, S.E. in prep. Marine mammal resources of the Admiralty Inlet-Navy Board Inlet area, northern Baffin Island. Fish. Mar. Serv. Tech. Rept.

In addition, the Canadian Wildlife Service (D.N. Nettleship, A.J. Gaston) is conducting ongoing studies of the ecology of seabirds at Prince Leopold Island and of the sizes of other colonies in Lancaster Sound. These studies will terminate in 1977 and will provide valuable information when published.

This printing of the report includes additional details concerning four studies done in Lancaster Sound by LGL Ltd. for Norlands Petroleum Ltd. during 1976. Extra pages have been inserted after pages 26, 126, 139 and 183 in order to further describe the findings of Sekerak et al. (1976b), Bradstreet (1976), and Johnson et al. (1976a, b).

SUBJECT INDEX

Within this index pertinent references are listed alphabetically under major subject titles. The contents of each report are summarized in a few words beside the citation. Most references are listed under only one major subject title. Most reports listed under 'Interdisciplinary Studies' contain information relevant to numerous other major sections and the annotations should be consulted to determine the range of topics considered. Papers dealing with 'Ornithology' and 'Marine Mammalogy' are more comprehensively cross-referenced; general bird and mammal studies are listed under the 'General' subheadings and also under the appropriate individual species subheadings. The species indices in the 'Ornithology' and 'Marine Mammalogy' sections are arranged taxonomically; subtopics in other sections are arranged alphabetically.

This index restricts itself to information available in each annotation and does not provide a complete guide to the contents of the original reports that were reviewed; thus topics covered by the reports that were outside the range of interests of this bibliography are not indexed.

Abbreviations used in this index are listed below:

biol.	= biology	mig.	= migration
Ch.	= channel	mort.	= mortality
comp.	= composition	nos.	= numbers
dev.	= development	obs.	= observations
distrib.	= distribution	pop.	= population
est.	= estimate	R.	= River
Hr.	= harbour	Snd.	= Sound
I.	= Island	Str.	= Strait
imp.	= important	tax.	= taxonomy
In.	= Inlet	terr.	= terrestrial
incl.	= including	vert.	= vertical
lit.	= literature	YOY	= young-of-year

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B.C. Research 1975 (Strathcona Snd.).	5
Green & Steele 1975 (underwater obs.; Resolute)	7
Herlinveaux 1970 (underwater obs.).	9
Kramp 1963 ('Godthaab' zoological results).	10
Lalli <i>et al.</i> 1973 (overview).	11
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Franceschetti <i>et al.</i> 1964 (P,N,Si; N Baffin Bay)	45
Sekerak <i>et al.</i> 1976a (P,N,Si; Assistance Bay, Creswell Bay)	25
Thomson <i>et al.</i> 1975 (P,N,Si; Barrow Str., Austin Ch., Cunningham Inlet)	27
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(See also section on 'Primary Production')

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INTERDISCIPLINARY STUDIES (PHYSICAL, CHEMICAL, BIOLOGICAL)

With one exception, all of the studies annotated in this section are highly relevant to impact assessment and prediction within our study area. The exception, Kramp (1963), is a summary of the zoological results of the 'Godthaab' Expedition of 1928; the original papers on which Kramp's summary is based are summarized in the appropriate sections of this bibliography.

The most pertinent aspects of each report have been emphasized in the annotations that follow. However, if a detailed impact study is undertaken it would probably be necessary to refer to the original reports.

- Bain, H., D. Thomson, M. Foy, and W. Griffiths. 1977. Marine ecology of fast-ice edges in Wellington Channel and Resolute Passage, N.W.T. In: A.D. Sekerak (Ed.), Studies of the ecology of fast-ice edges in the High Arctic. Unpubl. Rept. by LGL Ltd. to Polar Gas Project.

This report was not completed at the time of this review. Therefore, the following summary must be considered preliminary.

Scope

The aim of the study was to determine the general marine biological characteristics of the Wellington Channel and Resolute-Griffiths Island ice edges during June and early July. Several areas of bird and mammal congregation were studied in detail.

Study Design

Work was done through the ice and on open water transects out from the ice edge. Temperature and salinity measurements and macronutrients (phosphate, nitrate, silicate), chlorophyll *a*, and phytoplankton samples were taken, usually at depths of 0, 7.5, 15, and 25 metres. Zooplankton was sampled by horizontal Miller tow and by $\frac{1}{4}$ m closing nets hauled vertically (25 to 0 m; 50 to 25 m). Mesh sizes were 239 μ m and 569 μ m. Benthos was sampled by Ponar grab and small otter trawl (3.8 cm mesh; cod end liner of 0.3 cm mesh). Fish were sampled by plankton tows, gill nets, cob trawl, otter trawl, and jigging.

Preliminary Summary of Major Findings

Physical measurements

The upper 25 m was generally stable. Near surface water was usually warmer in open water than under-ice, presumably due to solar heating.

The temperature and salinity in the upper 25 m of Wellington Channel ranged from -1.79 to 1.67 °C and 23.9 to 33.4‰, respectively. Temperatures in Resolute Passage (only one station - open water) ranged from -1.61 to -1.58 °C. The upper 25 m of water was isohaline at 32.2‰.

Chlorophyll *a*

<u>Location</u>	<u>Range</u>
Wellington Channel	0.04 to 9.51 mg/m ³
Resolute Passage	0.13 to 0.34 mg/m ³

Nutrients

Comparison of Minimum and Maximum Concentrations of Macronutrients Recorded in the Upper 30 m of Water for Various Locations in the Eastern Canadian Arctic

Location	Date	Reactive Nitrate (mg-at N/m ³)		Reactive Phosphorous (mg-at P/m ³)		Reactive Silicate (mg-at Si/m ³)	
		Min.	Max.	Min.	Max.	Min.	Max.
Wellington Channel	2-29/6/76	0.09	9.86	0.48	1.19	0.20	15.24
Resolute Passage	5/7/76	6.42	9.94	0.86	1.24	7.09	13.89
East Barrow Strait ¹	-	-	-	0.50	1.00	5.00	10.00
Kane Basin ²	28-30/7/63	0.00	0.55	0.33	1.21	0.01	0.11
Kennedy Channel ²	29/7/63	0.00	0.37	0.35	2.53	0.01	0.10
Smith Sound ²	30/7/63	0.00	0.39	0.46	0.91	0.01	0.09
Northern Baffin Bay ²	31/7/63- 4/8/63	0.00	0.54	0.24	1.41	0.00	0.08
Cunningham Inlet ³	14-27/8/74	0.50	6.00	0.30	1.00	-	-
Creswell Bay ⁴	2/8/75	<0.05	0.65	0.49	0.72	0.70	2.71
Assistance Bay ⁴	19-25/8/75	<0.05	0.54	0.49	0.94	0.23	1.54

¹Codispoti & Owens (1975)

²Franceschetti *et al.* (1964)

³Thomson *et al.* (1975)

⁴Sekerak *et al.* (1976)

Phytoplankton

The following summary of phytoplankton results was prepared by M. Foy, phytoplankton taxonomist at LGL Ltd.

1. Standing stock of the phytoplankton community along the Wellington Channel ice-edge as measured by chlorophyll *a* concentration and cell numbers was relatively high; maximum values are among the highest recorded from arctic waters at any time of year.
2. *Nitzschia grunowii* completely dominated and characterized the 'spring' phytoplankton community along the Wellington Channel ice-edge in June. *Nitzschia seriata* and *Thalassiosira nordenskioeldii* occurred in smaller numbers but were also important. *Chaetoceros socialis*, generally considered a 'summer' species, increased in importance towards the end of June.
3. Sufficient data were not collected to be able to compare areas along the ice-edge; however, the overall composition of the communities was similar at all areas, and it would appear that the quantitative differences found may have resulted primarily from temporal rather than spatial variations in conditions affecting phytoplankton growth.
4. It is probable that a peak in standing stock of this pennate diatom 'spring' bloom occurred in the middle of June; after this time cell numbers and chlorophyll values began to decline. The percentage of total numbers contributed by *N. grunowii* also began to decline while that contributed by *C. socialis* began to increase.
5. No major differences were noted between the phytoplankton populations of the stations from under the ice and those of the stations in the open water when differences in time of sampling

were accounted for. Because of the strong southward moving currents in Wellington Channel, the phytoplankton populations sampled from the open water were probably the same as those sampled from under the ice.

6. The populations of phytoplankton demonstrated no consistent depth preference; the variations observed probably resulted from a combination of factors including tidal action and light intensity.
7. The phytoplankton community along the Resolute Passage ice-edge sampled in early July exhibited a low standing stock and differed considerably in composition from the populations along Wellington Channel.

Zooplankton

The zooplankton analyses are not complete. Preliminary results are listed here.

1. Approximately 35 species have been identified.
2. *Pseudocalanus* spp. were generally the dominant copepods in terms of numbers of individuals.
3. The copepods *Calanus glacialis* (copepodite IV) and *C. hyperboreus* (copepodite V) were the dominant zooplankters in terms of biomass.
4. Pteropods were generally scarce and of small size.
5. *Parathemisto libellula* was the most common amphipod and *Sagitta elegans* young was the most common chaetognath.
6. Benthic larvae, particularly barnacle nauplii, were at times extremely abundant.

Benthos

Analysis is incomplete.

Fish

All fish were caught in bottom trawls in the Resolute Bay area except for 'young of the year' (YOY) Arctic cod. The Arctic cod (YOY) were captured by plankton net. Approximately 9 juvenile cod were captured by bottom trawl. Four species of benthic fish were also collected.

The fish section of the report will contain data on size ranges, sex, state of maturity and stomach contents when possible. The Arctic cod juveniles will be aged. The Arctic cod (YOY) will be analyzed for density, depth distribution, length frequency, growth rate and stomach contents.

● B.C. Research. 1975. Baseline survey of the marine environment at Strathcona Sound, N.W.T. Progress Report No. 1. Unpubl. Rept. to Strathcona Mineral Services. 84 pp.

This study was an environmental baseline survey conducted for the Strathcona Sound lead-zinc mining interests. It included observations of currents, salinity, temperature, dissolved oxygen, pH and surface turbidities. Seawater samples, seaweeds, fish, sediments and invertebrates were collected and analyzed to determine background levels of trace metals.

Physical measurements, though hampered by technical difficulties with salinity analyses, indicated a generally stable water column. Low salinities and high temperature at the surface were attributed to freshwater runoff. Current measurements were not extensive and direction was not determined but week bottom currents were measured at one station over the sill near the entrance to Strathcona Sound. Dissolved oxygen levels at this one station were also considerably higher (about 7.0 ppm) below 100 m than at all the other stations (<5.0 ppm). The oxygen data appear to support the current

measurements in illustrating a subsurface exchange with Admiralty Inlet, though this is not stated in the text. Near-surface current velocities ranged from 0 to 29 cm/sec.

Collection and analysis of samples for trace metals is a notoriously meticulous and difficult operation if consistent and accurate data are to be obtained. This is in part evident from the stated discrepancies between some of the Fisheries and Marine Service data and the higher values obtained by B.C. Research. However, it is not possible from this report to fully assess the reliability of techniques employed.

There appeared to be some natural contamination from streams in the vicinity of the ore body and this was particularly evident in the sediments and seaweed. Trace metal levels in the seawater were comparable to those from other non-industrial areas except for higher zinc levels. Most trace metal concentrations in seaweed, fish, sediments and invertebrates were commensurate with other undeveloped localities.

The biological information contained in this report is inadequate for impact assessment due to a lack of identifications of invertebrate species (apparently not available in time for inclusion in the report) and quantitative data.

The report concludes that '... in the long term, controlled marine disposal offers appreciably less risk [than terrestrial embankment] of contamination of the sensitive surface zone of Strathcona Sound with dissolved or particulate heavy metals'.

The applicability of this Strathcona Sound environmental study to other areas is obviously limited by its specific nature. There is, however, general interest in a distributional sense for some of the fauna collected, particularly the Greenland Shark which appears to be widely distributed throughout the eastern portion of the Canadian High Arctic. The polychaetes, which were the only invertebrates identified to species, are also of some

interest. The observation of schools of small (< 3 inches) Arctic cod (*Boreogadus saida*), an important Arctic fish whose habits are not well known, is of particular interest.

● Green, J.M. and D.H. Steele. 1975. Observations on marine life beneath sea ice, Resolute Bay, N.W.T. In: Proc. Circumpolar Conf. on Northern Ecology. 15-18 Sept. 1975, Ottawa. Section II : 79-86.

Scope

Visual observations and collections were made during shallow under-ice dives (SCUBA) in Resolute Bay (Dec. 1972 and June 1974). Major emphasis was on amphipods and fish but species lists and comments are included for zooplankton and benthos in general.

Methods

Collections were made with small, fine mesh dip nets and minnow traps lined with fine nylon netting. The traps were placed on the sea floor, in mid-water and against the undersurface of the ice. Zooplankton was collected in vertical tows by $\frac{1}{4}$ m nets.

Results

14-22 December 1972 (Zooplankton)

Nine copepod species were collected--six were common Arctic species and three were rare *Monstrilla* species.

The amphipod *Parathemisto libellula* and the medusa *Cyanea capillata* were common near the surface. The amphipods *Anonyx nugax* and *Pseudalibrotus littoralis*, which are important scavengers, were both very common and were attracted to baited minnow traps. The latter species was most abundant at the surface. The amphipods *Gammarus setosus* and its predator *Gammaracanthus loricatus* were common near the ice but were not strongly attracted to the traps.

1-8 June 1974 (Zooplankton)

Pelagic and under-ice fauna was generally much reduced. Copepod and cirripede nauplii were very common. *P. libellula* had virtually disappeared but *C. capillata* was still common. *G. setosus* and *G. loricatus* were common in ice cracks and *P. littoralis* was extremely abundant just under the ice. [Note that June data were not collected during the same winter season as December data.]

Infauna

The infaunal benthos was not observed systematically. However, the bivalve mollusc *Mya truncata* appeared to be the dominant species.

Epibenthos

The brittle star *Ophiura sarsi* was the dominant organism (5-10/m²). Some were commencing reproduction in June.

The isopod *Munnopsis typica* was more common in December than June.

The mud shrimp *Sclerocrangon boreas* was buried in December but active and moulting in June.

Epifauna

Scattered rocks and particularly the benthic algae (attached macrophytes) supported a diverse fauna. The whelk *Buccinum belcheri* and the starfish *Lepasterias groenlandicus* were observed carrying eggs in June.

'Black holes'

These contained dead benthic organisms and were observed under ice stalactites in June.

Fish

A total of eleven species were collected. All species were caught on or near the bottom except for the Arctic cod, *Boreogadus saida*, and one specimen of *Pungitius pungitius* (stickleback). Arctic cod were common during both observational periods in mid-water and near the ice. They

were netted in the dive holes and taken from the medusa *C. capillata*. All fish species were actively feeding on amphipods in December and June.

Discussion and Summary

1. Offshore amphipod species and those that associate with old ice (*Pseudalibrotus glacialis*, *Gammarus wilkitzki*) were not collected.
2. The pelagic fauna was much reduced in June 1974. The reasons for this are uncertain since ice melt had not commenced at the time of sampling. Furthermore, when ice melt did begin it would presumably only affect the upper several metres and thus would not reduce the fauna below this depth. The authors' do not, however, mention the possibility of 'year to year' variability.
3. The dead animals that were observed in the 'black holes' on the bottom were assumed to be the result of brine from ice stalactites accumulating in bottom depressions.

Relevance

The species lists are useful in denoting presence or absence. The observations on vertical distribution and behaviour are particularly relevant. The observations of Arctic Cod and amphipods under the ice are of special interest because of the importance of these species in Arctic food chains and the paucity of knowledge about their distributions and activities.

- Herlinveaux, R.H. 1970. Icepack 8/68 - oceanographic and biological observations. Fish. Res. Bd. Canada Tech. Rept. No. 159. 60 pp.

Temperature, salinity and oxygen data collected by the 'Labrador' at 32 stations in August and September 1968 are presented in tabular form.

Sampling locations included northern Baffin Bay, Jones Sound, Norwegian Bay, Wellington Channel, Resolute Bay, McClure Strait, Lancaster Sound, the entrance to Navy Board Inlet, Milne Inlet, Eclipse Sound and Pond Inlet. Biological observations were made from the submersible 'Pisces I' at Winter Harbour, Resolute Bay, Norwegian Bay, western Jones Sound, northern Lancaster Sound, Pond Inlet and Milne Inlet. Observations from the submersible were limited to visual observations, photography and some incidental bottom collections.

Relevance of this study's findings to an impact study are primarily confined to the physical measurements. However, certain biological observations are interesting, particularly the sighting of a large school of herring (each about 17.5 cm in length) at Pond Inlet; these fish had been first detected as a scattering layer at 20 fathoms. The observation of an octopus in Resolute Bay was also interesting. However, the qualitative biological observations are of little value except to denote presence of certain species.

● Kramp, P.L. 1963. Summary of the zoological results of the Godthaab Expedition 1928. *Medd. Grønland*. 81(7):1-115.

This paper summarizes the 27 zoological papers (mainly plankton, abyssal fauna, and some littoral and sublittoral fauna--primarily of W Greenland) that originated from the 'Godthaab' Expedition of 1928.

Although a hydrographical section was made across Lancaster Sound from Cape Warrender southward, biological data were not collected there because of bad weather. Two plankton hauls were taken off the eastern entrance to Lancaster Sound (one in the cold surface layer and one in the warmer sub-surface layer) and bottom fauna was collected at one location.

The relevance of this paper to impact assessment is limited. It gives some indication of the presence and absence of certain species. However, even for that one would probably prefer the greater detail of the original papers listed elsewhere in this bibliography.

- Lalli, C.M., R. Buchanan, D. Thomson and F. Wells Jr. 1973. Polar Gas Preliminary Environmental Study : Marine Ecology Report. Unpubl. McGill University Rept. to Polar Gas Project. 98 pp.

This report is the most comprehensive synthesis of pre-1973 literature of relevance to the marine ecology of the Canadian Arctic Archipelago. The purpose of the report was to evaluate the existing literature and to make recommendations on future research required to fill major gaps in the then-present knowledge of the Polar Gas pipeline routing areas. Recommendations were also made concerning research necessary to evaluate the impact of pipeline construction and maintenance.

It is evident from this report that very few biological studies had been undertaken previous to 1973 in the Polar Gas study area *per se*. Approximately 500 scientific publications were surveyed with about 200 having at least some general relevance.

Physical oceanography of the Arctic Ocean and Canadian Archipelago was discussed briefly, mainly in relation to biological implications. Seabirds and Polar Bears, which were outside the scope of the report, were occasionally mentioned.

The following is taken from the authors' preface and represents the general conclusions and recommendations of this 'office' study.

'Our literature survey of marine life in the eastern Canadian Arctic has pointed out major deficiencies in present knowledge. Among these are: the lack of long-term detailed studies within the area; lack of quantitative data on abundance or productivity; absence of winter information; no information on micro-organisms and their role in cold water ecology; insufficient knowledge of food relationships in the marine ecosystem; and no information on the behaviour of natural gas (or methane) in cold seawater and its effects on marine organisms.

'We have attempted to present a general view of marine ecology in arctic waters based largely upon data collected outside the study area. The following summarizes major points relevant to the report: Primary production by phytoplankton, ice diatoms, and benthic plants is restricted to the brief seasonal light period. The stratification and vertical stability of the water column in most of this area result in rapid depletion of essential dissolved nutrients from surface waters by phytoplankton. The combination of a short light period and low nutrient concentrations results in open arctic waters being the least productive of marine environments. All of the marine groups are characterized by low species diversity. Low food levels and low temperatures apparently act together to slow growth rates and lengthen life cycles in many zooplankton and benthic animals and in at least some fish species. Long reproductive cycles are characteristic of marine mammals. The slow growth rates and long reproductive cycles make the arctic marine fauna particularly vulnerable to damage as repopulation would consequently be slow. Few benthic animals produce pelagic larvae, therefore their dispersal to new areas or repopulation of disturbed or damaged areas would be especially slow. Of approximately 50 species of fish reported from the area, none would appear to be abundant enough in the study area to form the basis of a profitable commercial fishery; however, several of the fish species are eaten by marine mammals and some are utilized by native peoples. Nine species of marine mammals occur within the study area either as permanent residents or as temporary migrants. Major migration routes do not appear to extend west of the Boothia Peninsula.'

This Polar Gas preliminary study is a valuable overview of the marine ecology of the eastern Canadian High Arctic. It is also reasonably readable to a knowledgeable layman. For these reasons it is quite relevant as a general introduction to Lancaster Sound and adjacent waters.

- Sekerak, A.D., D. Thomson, H. Bain and J. Acreman. 1976a. Summer surveys of the marine ecology of Creswell Bay, Somerset Island and Assistance Bay, Cornwallis Island, N.W.T. 1975. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 215 pp.

This report contains baseline data on chlorophyll *a* concentrations, phytoplankton, benthic flora, zooplankton, benthic invertebrates and fish. The biological data were supplemented by information on nutrient concentrations (reactive phosphorous, nitrate, and silicate), temperature, salinity, substrate and water depth. Attempts were made to determine the major components of the phytoplankton, zooplankton, and benthic communities and where possible to fill major gaps in the knowledge of marine nearshore food chains. This study was done in conjunction with Polar Gas studies of birds (see Alliston *et al.* 1976) and marine mammals (see Finley 1976).

The major findings are best summarized by Tables a-i, which are taken directly from the text.

Nutrient concentrations were low near the surface in both Assistance Bay and Creswell Bay (Tables a,b), presumably because of utilization in phytoplankton production. Nutrient replenishment was assumed to be minimal due to an apparently stable water column. Nitrate appeared to be the limiting nutrient in both areas because of its near exhaustion and therefore often undetectable levels.

Phytoplankton group composition in both areas was generally quite similar; diatoms were the dominant group both in numbers of species and in numbers of cells/l. *Nitzschia seriata* dominated the community in Creswell Bay, whereas, in Assistance Bay *Chaetoceros socialis* was most abundant. This was tentatively attributed to phytoplankton succession since *C. socialis* is thought to represent a climax community and Assistance Bay was sampled several weeks later than Creswell. The cell counts for these two locations were considered to be high relative to previous work in the Arctic (Table c). This was thought to be due, in part, to recent advancements in phytoplankton taxonomy and technique.

Table a.
Temperatures, Salinities and Macronutrient Concentrations in Three Areas in Creswell Bay,
August 1975.

Station	Water Depth m	Sampling Depth m	Temp. °C	Salinity 0/00	Reactive Nitrate mg-at N/m ³	Reactive Phosphorous mg-at P/m ³	Reactive Silicate mg-at Si/m ³
First Bay West (August 2)							
4	7	0	5.3	21.0	0.33	0.61	2.71
8	16	0	4.5	26.6	0.65	0.61	0.70
		10	1.4	30.0	0.08	0.81	1.17
7	88	0	3.0	28.4	< 0.05	0.49	1.75
		10	- 0.2	31.0	0.22	0.72	1.66
		50	- 1.4	32.2	4.07	1.36	6.86
Estuary of Creswell R. (August 3)							
12	1	0	-	16.6	-	-	-
13	1	0	-	16.0	-	-	-
14	3	0	1.8	22.8	0.82	0.38	2.47
		2	1.3	22.9	0.17	0.50	1.40
Near Estuary of Union R. (August 8)							
42	9	0	-	1.5	-	-	-
43	9	0	3.5	4.5	-	-	-
		5	1.9	26.6	-	-	-
43b	-	0	-	4.2	-	-	-
44	12	0	4.5	8.0	-	-	-
		5	2.5	27.8	-	-	-
		10	-	32.2	-	-	-

Table b.
Temperatures, Salinities, and Macronutrient Concentrations in Assistance Bay, August 1975.

Station	Water Depth m	Sampling Depth m	Temp. °C	Salinity 0/00	Reactive Nitrate mg-at N/m ³	Reactive Phosphorous mg-at P/m ³	Reactive Silicate mg-at Si/m ³
(August 19)							
60	1	0	1.4	30.5	< 0.05	0.83	0.23
62	25	0	0.8	30.5	0.30	0.85	0.58
		5	0.7	31.0	0.09	0.94	0.35
		10	0.4	31.0	0.03	0.61	0.31
(August 25)							
69	46	0	0.4	28.4	< 0.05	0.78	0.70
		10	0.3	29.5	0.14	0.49	0.68
		20	0.1	31.0	0.20	0.64	1.54
		30	- 0.1	32.2	0.54	0.93	1.29
		40	- 0.3	32.2	2.40	1.00	3.05

Table c.
Comparison of Surface Phytoplankton Counts
From Arctic and Northern Regions

<u>Location</u>	<u>Reference</u>	<u>No. Cells/l</u>
Cunningham Inlet, Somerset Island	Thomson <i>et al.</i> 1975	7.9×10^5
Igoolik, Northern Foxe Basin	Bursa 1961a	4.1×10^5
Sugluk - Stn.617 Ungava Penin.	Bursa 1961b	2.0×10^5
Point Barrow, Alaska	Bursa 1963	4.2×10^5 (max)
Scotch Cap, Alaska	Cupp 1937	0.1×10^5
Scoresby Sound, E. Greenland	Digby 1953	1.7×10^5
Faroe Isles	Steeman-Nielsen 1935	3.9×10^5
Cape Farewell, Greenland	Steeman-Nielsen 1935	3.9×10^5
Irminger Sea	Steeman-Nielsen 1935	4.0×10^5
Iceland, South Coast	Steeman-Nielsen 1935	9.1×10^5
Creswell Bay Somerset Island	Present Study	3.5×10^5
Assistance Bay Cornwallis Island	Present Study	10.0×10^5

Table d.

Abundance of Zooplankton and Number of Species Found in Creswell Bay and Assistance Bay (75 μ m mesh, $\frac{1}{2}$ m net, 10 min. tow)

Major Group	Creswell Bay		Assistance Bay	
	Average No. Animals/ Sample N = 6	No. Species Present Study	Average No. Animals/ Sample N = 2	No. Species Present Study
Copepoda				9
Nauplii	44,368	-	14,033	-
Calanoida	7,979	7	2,264	6
Harpacticoida	173	5	6	1
Cyclopoida	66	2	148	2
Amphipoda				3
Gammaridea	58	6	7	2
Hyperiid	6	3	60	1
Polychaeta	1	2	2	2
Pteropoda	38	2	5	1
Larvacea	16	2	26	2
Chaetognatha	< 1	2	< 1	1
Ctenophora	< 1	2	< 1	1
Gastropoda (larva)	-	-	40	?
Medusae	< 1	1	< 1	?
Pisces (young of the year)	5	4	2	1
Total	52,711	38	16,594	> 20

The zooplankton community (Table d) in both areas consisted mainly of the copepods *Calanus glacialis*, *C. hyperboreus*, *Oithona similis*, *Pseudocalanus minutus* (rare at Creswell); the pteropods *Clione limacina*, *Limacina helicina*; the larvaceans *Fritillaria borealis*, *Oikopleura vanhoeffeni*; the medusa *Aglantha digitale*; and the chaetognath *Sagitta elegans*. The largest number of zooplankton species and individuals were collected in one sample near floating pan-ice in Creswell Bay.

The benthos in Creswell Bay was found to be much 'richer' than that in Assistance Bay. See Tables e, f and g for comparisons between Creswell and Assistance Bays and other Arctic areas. This was attributed to the greater variety of habitat (i.e. substrate) in Creswell as opposed to a mainly rocky habitat in Assistance Bay. It was noted that the Ponar grab used in this study was unsuitable for sampling rock areas and this in itself would cause underestimates of the benthic populations.

Arctic Char were found to be abundant in shallow, nearshore water (<3.1 m) in Creswell Bay (based on 5 netting locations) and were assumed to be from the large Stanwell-Fletcher Lake population. They were found up to 35 km from the mouth of their 'home' river. No correlation could be found between age and their distance from the Union River. Data were compared to previous work in 1962 by Johnson and differences were noted in modal size classes. In addition, fewer char over 440 mm in length were caught in 1975 than in 1962. On the basis of age-length relationships, it appears that growth rates are steady and do not decrease up to at least 22 years of age. Weight-length relationships proved Creswell char to be similar to other High Arctic populations though the Creswell fish were slightly heavier per unit length. No significant difference was found between the numbers of males and females and ages of maturity were tentatively identified as 14 and 13 years, respectively. Refer to Table h for Arctic char diet data.

Table e.
Abundance of Benthic and Epibenthic Invertebrates in Arctic Regions.

Location	Depth m	Animals /m ²	No of Samples	Reference
Creswell Bay, (Somerset Island)	0 - 5 0 - 10 6 - 15 10 - 88	277 420 775 1284	7 11 23 22	Present Report " " " " " "
Assistance Bay, (Cornwallis Island)	10 - 56	386	15	" "
Assistance Bay, (Western Alternate)	2 - 56	685	5	" "
Cunningham Inlet, (Somerset Island)	0 - 5 0 - 10 6 - 15 10 - 40	890 1846 1635 1245	6 9 11 11	Thomson <i>et al.</i> 1975 " " " " " "
Barrow Strait and Peel Sound	32 - 290	426	21	" " "
Arctic Bay and Eclipse Sound, (Baffin Island)	0 - 3 5 - 14 5 - 47	381 1082 1815	11 8 23	Ellis 1960 " " " "
Disco Bay, (Greenland)	28 - 63	749	14	" "
Godthaab, (Greenland)	10	1729	39	" "
Frustration Bay, (Foxe Basin)	5 15 - 30	282 209 - 264	6 20	" " " "
Western Beaufort Sea	23 - 30 46 - 52	1350 2120	27 20	Carey <i>et al.</i> 1974 " " "
Upernavic, (Greenland)	8 - 64	1898	13	Vibe 1939
Prøvens Havn, (Greenland)	8 - 19	1481	7	" "

Table f.
Group Composition and Abundance (animals/m²) and Number of Species of Benthic and Epibenthic Invertebrates in four High Arctic Regions.

Group	Creswell Bay Depth Range 1-88 m N = 44		Assistance Bay & Western Alternate Depth Range 1-56 m N = 18		Cunningham Inlet* Depth Range 2-40 m N = 23		Barrow Strait, Peel Sound* Depth Range 32-270 m N = 19	
	Animals/m ²	# Species	Animals/m ²	# Species	Animals/m ²	# Species	Animals/m ²	# Species
Polychaetes	445	52	190	25	608	53	250	28
Bivalves	147	15	20	7	277	16	87	11
Amphipods	119	29	8	4	131	8	9	5
Other crustaceans	102	12	156	5	135	7**	6	7**
Echinoderms	21	8	24	6	14	4	113	14
Gastropods	15	12	30	9	45	12	22	7
Other animals	6	7	21	7	45	4	9	3
Totals	855	135	449	63	1255	104	496	75

* From Thomson *et al.* 1975.

** Species of Cumaceans not identified.

Table g.
Ten Most Common (no./m²) Species of Benthic or Epibenthic Invertebrates in
Four High Arctic Regions

Creswell Bay (August 1975)			Assistance Bay and western alternate (August 1975)		
Depth Range	1-88 m	N=44	Depth Range	1-56 m	N=18
<i>Owenia fusiformis</i> (P)	103		<i>Balanus crenatus</i> (C)		142
<i>Ostracoda</i> (C)	61		<i>Spirorbis spirillum</i> (P)		76
<i>Heteromastus filiformis</i> (P)	43		<i>Spirorbis granulatus</i> (P)		45
<i>Chaetozone setosa</i> (P)	43		<i>Castalia aphroditoides</i> (P)		17
<i>Micronephthys minuta</i> (P)	36		<i>Cirriatulus cirratus</i> (P)		12
<i>Portlandia arctica</i> (B)	27		<i>Etone spitzbergensis</i> (P)		9
<i>Pontoporeia affinis</i> (A)	23		<i>Hiatella arctica</i> (B)		9
<i>Castalia aphroditoides</i> (P)	9		<i>Ophuira robusta</i> (E)		8
<i>Astarte borealis</i> (B)	7		<i>Strongylocentrotus droehbachensis</i> (E)		7
<i>Onisimus littoralis</i> (P)	18		<i>Tonicella rubra</i> (Ch)		6
% of Total	44		% of Total		74
Cunningham Inlet (August 1974)*			W. Barrow St. and Peel Sound (August 1974)*		
Depth Range	2-40 m	N=23	Depth Range	32-270 m	N=19
<i>Ostracoda</i> (C)	157		<i>Niomache personata</i> (P)		76
<i>Portlandia arctica</i> (B)	123		<i>Myriochele heeri</i> (P)		62
<i>Pontoporeia femorata</i> (A)	53		<i>Ophuira robusta</i> (E)		54
<i>Leaena abbranchiata</i> (P)	51		<i>Onuphus conchylega</i> (P)		35
<i>Chaetozone setosa</i> (P)	51		<i>Yoldiella</i> sp. (P)		32
<i>Atylus carinatus</i> (A)	45		<i>Maldane sarsi</i> (P)		28
<i>Terebellides stroemi</i> (P)	44		<i>Petaloproctus tenuis</i> (P)		23
<i>Spirorbis spirillum</i> (P)	44		<i>Spirorbis borealis</i> (P)		20
<i>Myriochele heeri</i> (P)	38		<i>Acmaea testudinalis</i> (G)		17
<i>Sabella crasicornis</i> (P)	38		<i>Ophiopleura borealis</i> (E)		15
% of Total	48		% of Total		74

* From Thomson *et al.* 1975.

A = Amphipod B = Bivalve Ch = Chiton C = Crustacea

E = Echinoderm G = Gastropod P = Polychaete

Table h. Summary of the Number of Major Taxa, Number of Species and the Predominant Food Items Consumed by Anadromous Arctic Char from Various Areas in the Canadian Arctic.

Location	Date	Sample Size	Stomach Content		Predominant Food Items	Reference
			No. of Major Taxa Consumed	No. of Species Consumed		
Creswell Bay (Somerset Is.)	July 30-Aug. 13, 1975	82	10	31	amphipods	present study
Frobisher Bay (Baffin Is.)	June 26-Sept. 5, 1948, 1950, 1951	450	11	30	amphipods (<i>Onisimus</i> sp.)	Grainger (1953)
Adlorilik (Ungava Bay)	July 4, 1951	1	4	9	decopod larvae; fish (<i>Myoxocephalus</i> sp.)	Grainger (1953)
George River (Ungava Bay)	July 23, 1951	13	4	4	fish; (<i>Ammodytes</i> sp.)	Grainger (1953)
Herschel Is. (Yukon Territory)	August 17-19, 1951	23	3	5	amphipods, (<i>Parathemisto libellula</i>) fish, (<i>Myoxocephalus groenlandicus</i>)	Grainger (1953)
Adlatok, Nain and Okkak Bay (Northern Labrador)	July-August, 1953	364	3	N.A.	fish, (<i>Mallotus villosus</i>)	Andrews and Lear (1956)
Hebron and Ramah, (Northern Labrador)	July-August, 1953	239	3	N.A.	amphipods; euphausiids	Andrews and Lear (1956)
Cumberland Sound, Site A (Baffin Island)	July, 1972	40-60	4	8	amphipods, (<i>Parathemisto libellula</i>)	Moore and Moore (1974)
Cumberland Sound, Site C (Baffin Island)	August, 1972	40-60	4	9	amphipods, (<i>Parathemisto libellula</i>) fish, (<i>Boreogadus saida</i>)	Moore and Moore (1974)
Nunaluk Lagoon area (Yukon Territory)	June-Sept., 1974	206	12	N.A.	fish, (<i>Myoxocephalus quadricornis</i>)	Griffiths et al. (1975)

N.A. indicates that the data are not available.

Table i.

Comparison of the Stomach Contents of Fourhorn Sculpins Caught in Two Depth Zones. illustrating the importance of amphipods in their diet, but the absence of *Anonyx nugax* in sculpins from shallow water.

Depth of Capture	0.9-15.0 m				> 15.0 m			
	Total Number	Mean $\pm$	S.D.	% of Total	Total Number	Mean $\pm$	S.D.	% of Total
Sipunculida								
Unidentified sipunculid	1	0.06 $\pm$	0.24	0.21	-	-	-	-
Gastropoda								
<i>Limacina helicina</i>	4	0.22 $\pm$	0.94	0.87	124	13.78 $\pm$	41.33	24.80
Mysidacea								
<i>Mysis littoralis</i>	-	-	-	-	1	0.11 $\pm$	0.33	0.20
Amphipoda								
Gammaridea								
<i>Anonyx nugax</i>	-	-	-	-	4	0.44 $\pm$	1.01	0.80
<i>Apherusa glacialis</i>	12	0.67 $\pm$	1.91	2.61	-	-	-	-
<i>Gammaracanthus</i> sp.A.	5	0.28 $\pm$	1.18	1.09	-	-	-	-
<i>Gammaracanthus</i> sp.B.	3	0.17 $\pm$	0.51	0.65	1	0.11 $\pm$	0.33	0.02
<i>Gammaracanthus</i> sp.C.	2	0.11 $\pm$	0.47	0.43	-	-	-	-
<i>Gammarus setosus</i>	46	2.56 $\pm$	3.75	10.0	71	7.89 $\pm$	11.53	14.20
<i>Ischyrocerus anguipes</i>	20	1.11 $\pm$	2.47	4.35	1	0.11 $\pm$	0.33	0.20
<i>Monoculodes borealis</i>	1	0.06 $\pm$	0.24	0.21	-	-	-	-
<i>Onisimus glacialis</i>	5	0.28 $\pm$	0.75	1.09	8	0.89 $\pm$	2.67	1.60
<i>Onisimus littoralis</i>	266	14.78 $\pm$	26.35	57.83	260	28.89 $\pm$	33.01	52.00
<i>Onisimus</i> spp.*	76	4.22 $\pm$	12.54	16.52	28	3.11 $\pm$	6.19	5.60
<i>Orchomenella</i> sp.	9	0.50 $\pm$	2.12	1.96	-	-	-	-
<i>Paroediceros lynceus</i>	1	0.06 $\pm$	0.24	0.21	1	0.11 $\pm$	0.33	0.20
<i>Pontoporeia affinis</i>	1	0.06 $\pm$	0.24	0.21	1	0.11 $\pm$	0.33	0.20
<i>Pontoporeia femorata</i>	2	0.11 $\pm$	0.32	0.43	-	-	-	-
Hyperiid								
<i>Parathemisto libellula</i>	2	0.11 $\pm$	0.32	0.43	-	-	-	-
Unidentified amphipods	2	0.11 $\pm$	0.47	0.43	-	-	-	-
Pisces								
Unidentified fish remains	2	0.11 $\pm$	0.32	0.43	-	-	-	-
Totals	460	-	-	99.96	500	-	-	100.0
Number of Stomachs Analyzed	19					11		
Number of Empty Stomachs	1					2		

* *Onisimus* spp. are probably composed of *O. littoralis* and *O. glacialis*.

It should be noted that some of the above characteristics (few specimens of maximal size and age, steady growth rates of older specimens, increased weight per unit length) are typical patterns and responses of an exploited fish population. The char population utilizing Creswell Bay has been subject to increased subsistence fishing in recent years and in 1976 supported a small commercial fishery (Sekerak pers. comm.)

The only other species of fish collected was the Fourhorn Sculpin. Information about its size distribution, growth rate, sex ratios and diet (Table i) is presented.

Diets of the char and sculpins collected at Creswell Bay included many amphipods (see Tables h, i). Birds collected at Creswell Bay (see Alliston *et al.* 1976) were also largely dependent on amphipods; quantitative information about the shallow water amphipods is presented in that report. In all, 31 species of amphipods were collected. Seven were pelagic and 24 were benthic and epibenthic species.

Sekerak, A.D., R.A. Buchanan, W.B. Griffiths and M.G. Foy. 1976b. Biological oceanographic studies in Lancaster Sound, 1976. Unpubl. Rept. by LGL Ltd. to Norlands Petroleums Ltd. 169 pp.

This report documents the most intensive plankton study that has been conducted in Lancaster Sound. The study was done in conjunction with aerial surveys of birds and marine mammals (see Johnson *et al.* 1976a,b) and a ship-based study of seabird distribution and feeding habits (Bradstreet 1976). Six stations including Cape Warrender, Cape Sherard, Navy Board Inlet and three mid-sound stations (one as far west as Prince Regent Inlet) were sampled five times throughout the summer. Figure a shows the locations of the six stations in relation to currents. Samples and measurements included particulate hydrocarbons, illuminance, temperature, salinity, density, oxygen, chlorophyll α , phytoplankton and zooplankton.

The main value of this report to future impact studies is to the biologist and he is referred to the 60 pages of appended data on physical environment, specific identifications, vertical and horizontal distributions, occurrence of benthic larvae, etc. A physical oceanographer would probably find the location of stations (i.e., the lack of sectional information) and the inexact salinity measurements ($\pm 0.1\%$ at best) unsuitable for his purposes. The main value is as follows.

1. This report provides the only quantitative data presently available for phytoplankton and zooplankton in Lancaster Sound. Absolute numbers and biomasses of plankton must be handled with a certain appreciation for temporal and spatial vagaries of plankton distributions. However, it is quite clear that Lancaster Sound and Navy Board Inlet sustain relatively large amounts of phytoplankton. Although the exact mechanism for this is not known because of the lack of nutrient data, the results are obvious: This phytoplankton supports a large biomass of zooplankton which in turn provide a substantial and broad food base for vertebrates.
2. Major groups and major species of plankton are identified and their vertical distributions are noted. This is of particular importance to any monitoring study.

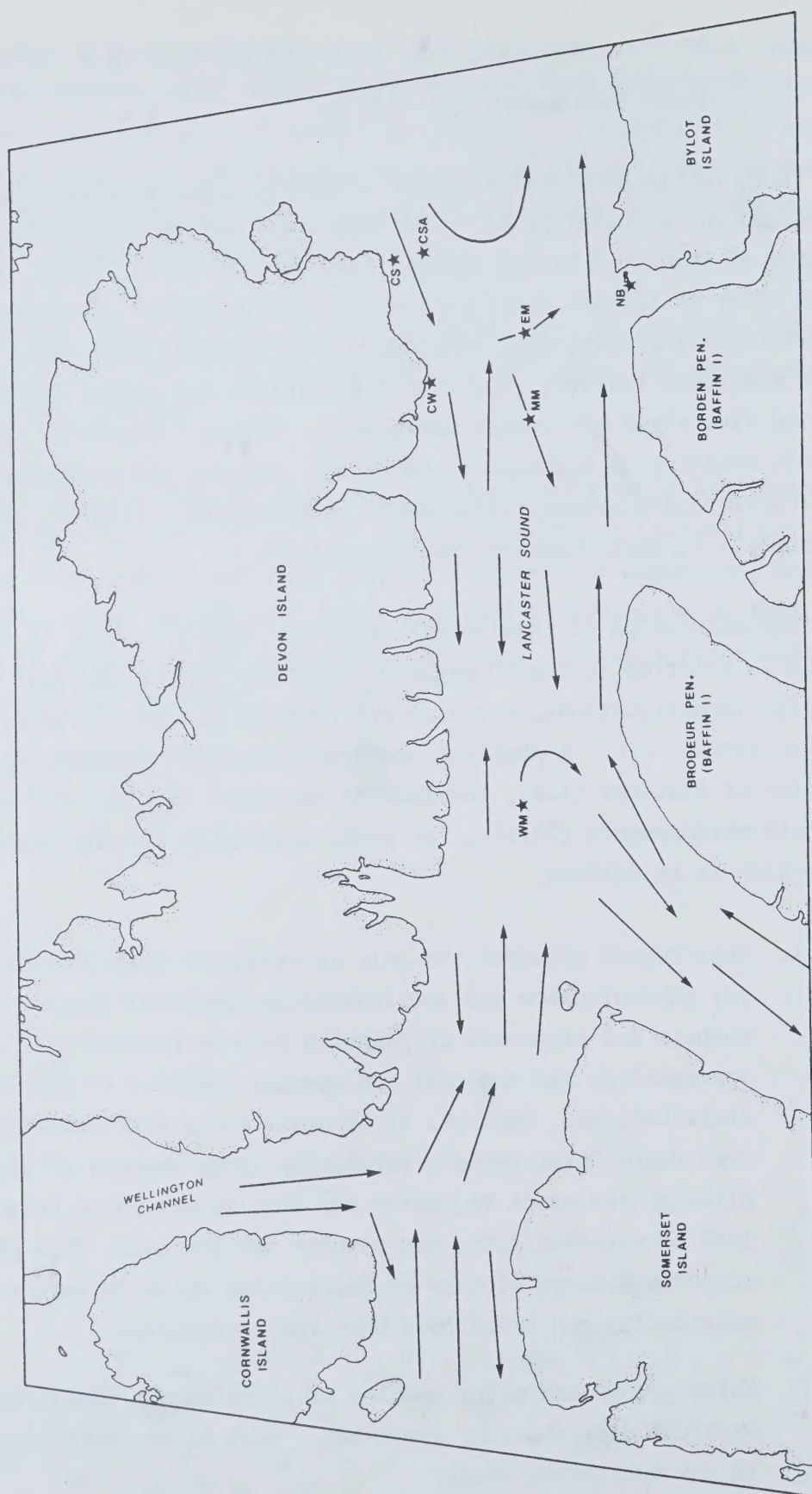


Figure a. Biological Oceanographic Stations in Lancaster Sound Sampled during 1976 (Sekerak *et al.* 1976b). Surface currents (arrows) are from Collin (1962).

● The following more detailed summary of the above report has become available since the first printing of the bibliography.

This report documents the most intensive plankton study that has been conducted in Lancaster Sound. The study was done in conjunction with aerial surveys of birds and marine mammals (see Johnson *et al.* 1976a,b) and a ship-based study of seabird distribution and feeding habits (Bradstreet 1976). Six stations including Cape Warrender, Cape Sherard, Navy Board Inlet and three mid-sound stations (one as far west as Prince Regent Inlet) were sampled five times throughout the summer. Figure a shows the locations of the six stations in relation to currents. Samples and measurements included particulate hydrocarbons, illuminance, temperature, salinity, density, oxygen, chlorophyll *a*, phytoplankton and zooplankton.

Physical measurements were in basic agreement with previous physical oceanographic studies. Baffin Bay water intrusion, though somewhat variable in thickness, was found at five stations below about 250 m but not at Navy Board Inlet where it was completely excluded by the shallow sill at the entrance. Navy Board Inlet appeared to be an area of very strong tidal mixing and a strong density inversion was recorded there between 25 and 50 m. Percent oxygen saturation values were relatively high throughout the water column. They were considerably higher at Navy Board than at the other stations from 300 m to the bottom. This indicated that the water in Navy Board Inlet at these depths had more recent contact with the surface than water at equivalent depths in Lancaster Sound.

Surface samples were taken by neuston sled at every station and in every time period. These thirty samples revealed no particulate hydrocarbons ('tar balls').

The phytoplankton community throughout the summer was typically Arctic in species composition. Diatoms were the most abundant group (75%), followed by chrysophytes (14%), microflagellates (9%) and dinoflagellates (2%), with negligible numbers of chlorophytes. *Chaetoceros socialis*, a diatom, was by far the dominant phytoplankton throughout the summer. Average cell counts

Table a. Comparison of Total Cell Counts Observed in Lancaster Sound
With Those From Other Northern Regions.

Location	Date	Depth (m)	Average Cell Counts x $10^4/\ell$	Reference
Igloolik (Northern Foxe Basin)	25/7/55 to 13/9/56	0	7.10	Bursa 1961a
		10	35.75	
		25	10.15	
		50	4.50	
Frobisher Bay, NWT	7/8/67 to 12/9/67	0	137.4	Bursa 1971
		10	303.4	
		30	145.2	
Mackenzie Bay (Beaufort Sea)	31/8/74	0	43.0	Foy and Hsiao 1976a
		5	44.1	
		10	1.4	
Point Barrow, Alaska	-	0	42.0	Bursa 1963
Scotch Cap, Alaska	-	0	0.01	Cupp 1937
South Coast Iceland	-	0	91.0	Steeman-Nielsen 1935
Faroe Isles	-	0	39.0	Steeman-Nielsen 1935
Lancaster Sound, NWT	23/7/76 to 13/9/76	0	228.3	Present Study
		10	268.6	
		25	248.2	
		50	58.6	

Table b. Comparison of Chlorophyll a Concentrations in Lancaster Sound with Those of Other Regions.

Location	Depth (m)	Chl a (mg/m ³)	Reference
Prudhoe Bay, Alaska	0	0.10	Horner et al. 1974
	3.5	7.40	
Western Bering Sea	0	0.62	Motoda, Minoda 1974
Bristol Bay, Alaska	0	2.49	Motoda, Minoda 1974
Oregon Coast	0	0.10-1.00	Small, Ramberg 1971
Antarctic (Atlantic)	0	0.01-118.35	El-Sayed 1971
(Pacific)	0	0.01-5.80	El-Sayed 1971
High Arctic Ocean	0	1.0-2.2	English 1967
Frobisher Bay, NWT 1967 - 1970	0	0.17-0.35	Grainger 1971
Lancaster Sound	0	1.23	Present Study
22 July - 13 September 1976	10	1.77	
	25	2.47	
	50	0.93	

showed a seasonal decrease except for several instances of very large concentrations in late summer. Highest average concentrations were found at Cape Warrender and eastern mid-sound.

Tables a and b compare this study's phytoplankton cell counts and chlorophyll *a* data with the only other available data for northern regions. These tables are taken directly from the report.

It is evident from these tables that Lancaster Sound supports a very high (for the Arctic) standing crop of phytoplankton. Though no primary production experiments were conducted in this study, the very high chlorophyll levels and the high oxygen levels all suggest a very high level of primary production.

Zooplankton in the upper 150 m of Lancaster Sound and Navy Board Inlet was quantified by vertical tows ($\frac{1}{2}$ m diam. nets, 239 μ m mesh). Densities were expressed as numbers of individuals per cubic metre. Estimates of biomass were expressed in mg of wet weight per cubic metre. Vertical distributions of all species were determined by horizontal tows at 0, 10, 50 and 150 m using nets equipped with closing devices. All nets were equipped with flowmeters to increase the accuracy of density and biomass estimates.

Few direct comparisons of zooplankton numbers in Lancaster Sound with those of other regions are possible due to general scarcity of such studies as well as differences in sampling methods and expression of results. Table c is taken directly from the text and compares zooplankton concentrations in Lancaster Sound and five other arctic areas. The higher counts recorded from Frobisher Bay were undoubtedly due to the much smaller mesh size used in that study. Table d summarizes the zooplankton biomass findings of this study and seven others. These comparisons strongly suggest that Lancaster Sound supports a much higher zooplankton biomass than other areas of the Canadian Arctic Archipelago that have been studied.

Copepods, primarily of the genus *Calanus*, were on an overall basis the most important group in the zooplankton community in terms of numbers and biomass. They constituted 36% of total zooplankton at the surface, 30% at

Table c. Comparison of Zooplankton Standing Crop of Arctic Regions.

Location	Depth Range Sampled (m)	Net Mesh Size (μm)	Time of Year	Nos./m ³		Reference
				Average	Maximum	
Frobisher Bay, Baffin Island	0 to 50	73	July	-	15,000	Grainger 1971
	0 to 50	73	Aug	-	12,000	Grainger 1971
	0 to 50	73	Sep	-	10,000	Grainger 1971
Assistance Bay, Cornwallis Island	0 to 50	233	mid Jul to mid Aug	3,405	11,577	Mohammed and Grainger 1974
Slidre Fjord, Ellesmere Island	0 to 50	233	mid Jul to mid Aug	477	719	Mohammed and Grainger 1974
Creswell Bay, Somerset Island	0 to 43	233	mid Jul to mid Aug	666	1,322	Mohammed and Grainger 1974
Arctic Basin	0 to 200	?	over one year	56	-	Hopkins 1969
Lancaster Sound, NWT						
CW	0 to 150	239	mid Jul to mid Sep	1,286	2,571	Present Report
CS	0 to 150	239	mid Jul to mid Sep	746	1,459	Present Report
EM	0 to 150	239	mid Jul to mid Sep	652	1,516	Present Report
MM	0 to 150	239	mid Jul to mid Sep	1,304	1,850	Present Report
NB	0 to 150	239	mid Jul to mid Sep	2,483	3,733	Present Report
WM	0 to 150	239	mid Jul to mid Sep	1,306	2,038	Present Report

Table d. Comparison of the Zooplankton Biomass in the First 150 m of Water in Lancaster Sound with that of Other Areas.

Area	Depth (m)	Season	Biomass (mg/m ³)	Reference
Bering Sea	0-800	Summer over 15 years	180-840	Motoda and Minoda 1974
Coastal NW Atlantic	0-400	Summer	840	Riley and Gorgy 1948 ²
Frobisher Bay, Baffin Island	0-50	Summer	~160-330 ¹	Grainger 1971
Foxe Basin SW Foxe Basin	0-50 0-100	Summer Summer	29-61 55	Grainger 1962 Grainger 1962
Assistance Bay Cornwallis Island	0-50	July-August	80	Mohammed and Grainger 1974
Slidre Fjord, Ellesmere Island	0-50	July-August	84	Mohammed and Grainger 1974
Creswell Bay, Somerset Island	0-40	July-August	192	Mohammed and Grainger 1974
Lancaster Sound Cape Warrender Cape Sherard East Mid-Sound Middle Mid-Sound Navy Board Inlet West Mid-Sound	0-150	July-September	247 (79-696) 240 (121-696) 246 (164-406) 181 (79-306) 284 (84-446) 263 (92-612) 171 (59-293)	Present Report Present Report Present Report Present Report Present Report Present Report

¹ Approximate maximum values from late July to October.

² Samples taken with Clarke-Bumpus samplers.

10 m, 57% at 50 m, and 85% at 150 m. From 0 to 150 m they accounted for 76% of total biomass. *Pseudocalanus* spp. were the most abundant copepods followed by *Calanus hyperboreus* and *C. glacialis*. *C. hyperboreus* was the most important copepod in terms of biomass due to its large size.

Parathemisto libellula and *P. abyssorum* were the dominant amphipods with the former species being more abundant near the surface and forming most of the amphipod biomass. This species is a predator of copepods and is an important link in Arctic food chains. *Parathemisto abyssorum*, a smaller species, was captured in maximum numbers at a depth of 150 m.

Larvaceans were the second most abundant group in Lancaster Sound, though there were some difficulties in obtaining quantitative estimates.

Gadids (cod) were by far the most important young-of-the-year fish collected in Lancaster Sound and were found in largest numbers at depths of 10 m and 50 m. Their average density was $0.052/\text{m}^3$ in the upper 150 m. This was substantially higher than the average density ($0.028/\text{m}^3$) found by Quast (1974) in the upper 50 m of the Chukchi Sea.

The main value of this report to future impact studies is to the biologist and he is referred to the 60 pages of appended data on physical environment, specific identifications, vertical and horizontal distributions, occurrence of benthic larvae, etc. A physical oceanographer would probably find the location of stations (i.e., the lack of sectional information) and the inexact salinity measurements ($\pm 0.1^\circ/\text{oo}$ at best) unsuitable for his purposes. The main value is as follows.

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2. Major groups and major species of plankton are identified and their vertical distributions are noted. This is of particular importance to any monitoring study.

- Sekerak, A.D. 1977. The importance of fast-ice edges to seabirds and mammals. *In*: A.D. Sekerak (Ed.), Studies of the ecology of fast-ice edges in the High Arctic, Unpubl. Rept. by LGL Ltd. to Polar Gas Project.

(Ultimately completed as Sekerak, A.D. and Richardson, W.J. 1978)

This report is still in preparation and therefore unavailable for review. It will integrate and present an overview of the interdisciplinary studies conducted by LGL Ltd. along the Resolute Passage and Wellington Channel ice-edges. These studies, Bain *et al.* (1977) on marine ecology, Finley and Bradstreet (1977) on bird and mammal distributions, and Bradstreet and Finley (1977) on the feeding ecology of seabirds are the first such studies to be conducted simultaneously. The integration of these reports should be a valuable addition to the knowledge of High Arctic food chains, seabird and mammal habitat and behaviour.

- Thomson, D., S. Woods, and J. Acreman. 1975. Marine ecology survey in the central portion of Canadian Arctic Islands 1974. Unpubl. McGill University Rept. to Polar Gas Project. 77 pp.

This report is a useful addition to knowledge of the marine ecology of the central Canadian Archipelago, mainly because of the almost total lack of previous marine biological work in this area. It is based on several types of data. During May 1974 three ice camps (one in West Barrow Strait and two in Austin Channel) were occupied; the data from these stations included baseline information on benthos, plankton, and ice biota supplemented by temperature and salinity measurements. Summer data were collected in Cunningham Inlet, Somerset Island, from 14-27 August; and from the CSS 'Hudson' in Peel Sound and West Barrow Strait from 27 August to 1 September.

The following is a summary of the main findings.

Observations from the Ice in West Barrow Strait and Austin Channel

1. Chlorophyll *a*, *b*, *c* concentrations in the ice:

<u>Location</u>	<u>Chlorophyll (mg/m²)</u>			<u>Phaeophytin</u>
	<u><i>a</i></u>	<u><i>b</i></u>	<u><i>c</i></u>	
W Barrow Strait	12.35	2.48	11.59	6.45
W Austin Channel	8.02	1.75	7.19	2.77
E Austin Channel	12.17	1.47	11.68	5.59

2. Chlorophyll *a* concentrations in the lower portion of the ice were much higher than in the water immediately below.
3. Highest levels of nitrate and phosphate in the ice were found in the lower portion. (P in lowest ice section ranged from about 0.25 to 2.00 mg-at/m³; N in the lowest section ranged from 1.25 to 1.90 mg-at/m³). Levels of these nutrients were somewhat higher in the water below.
4. Algae was concentrated in the lowest 3.5 cm of ice (7.89×10^7 cells/l). *Nitzschia frigida* (a diatom) was the overall dominant species in the ice. Total cell counts were much lower in the water below and *Nitzschia delicatissima* was the dominant species in Barrow Strait. In Austin Channel dominance of the phytoplankton community was shared by *N. frigida* and *Stauroneis quadripedis*.
5. Animals in the ice itself included one species of nematode and one species of cyclopoid copepod. The large amphipod *Anonyx nugax* was very common just under the ice in Barrow Strait and stomach analysis indicated that this species was probably feeding on the underside of the ice.
6. In general, the copepod *Calanus hyperboreus* dominated the under-ice zooplankton community with *Microcalanus pygmaeus* occasionally predominating.

7. Polychaetes dominated the benthic community, accounting for 45% of all animals taken (399 individuals/m² near Lowther Island and 694/m² in Austin Channel).

West Barrow Strait - late August (CSS 'Hudson')

1. Diatoms formed a lower percentage of the phytoplankton community than during the spring (26-38% compared to 96-99%). Phytoplankton counts were generally low (6.9×10^3 to 1.8×10^4 cells/l). *Chaetoceros* sp. was the dominant diatom.
2. *Calanus hyperboreus* was the dominant zooplankter in terms of biomass.
3. Polychaetes (average of 141 individuals/m²) dominated the benthic community.

Cunningham Inlet - 14-17 August 1974

1. Physical measurements showed a typical estuarine environment.
2. Nutrients were low at the surface (P: 0.30 - 0.70 mg-at/m³; N: 0.50 - 1.00 mg-at/m³). At the bottom, phosphate and nitrate reached 1.00 and 6.00 mg-at/m³ respectively. River runoff was found to be very low in nutrients.
3. Chlorophyll values and phytoplankton concentrations were generally low. Diatoms were dominant with *Chaetoceros* spp., *Nitzschia seriata*, and *Nitzschia delicatissima* being most abundant.
4. The surface zooplankton was dominated numerically by *Pseudocalanus minutus* and to a lesser extent *Acartia longiremis*. *Calanus hyperboreus* dominated in terms of biomass.
5. Observations were made along the low tidal interface; the amphipod *Gammarus setosus* was most conspicuous and was found in very high numbers.

6. The benthic community was generally dominated by polychaetes whose abundance decreased with depth. Near the Cunningham River the benthic community was dominated by the bivalve mollusc *Portlandia arctica*. Benthic algal growth was luxuriant and is probably important in the inlet's energetics.
7. Several species of sculpins were caught by benthic grab and gill net.

Quantitative data and additional details are contained in this report's appendix tables. Data taken from the 'Hudson' in Peel Sound (primarily on benthos) are also included in this report but are not reviewed here since Peel Sound is outside the study area. Some care should be taken in utilizing the quantitative information in other than a relative sense. For some cases, the data given were, of necessity, based on very few observations. In the case of zooplankton the quantities given should be taken as very gross approximations because of the collection methods used and because of the natural variation in zooplankton distribution.

The main value of this report to future impact studies is that it underlines the probable importance of ice biota and gives a preliminary idea of dominant invertebrate species that should be monitored before and after ecological damage.

PHYSICAL OCEANOGRAPHY

An in-depth review of physical oceanographic literature and data (including unpublished manuscripts, cruise data reports, etc.) was beyond the scope of this bibliography. However, physical processes are extremely important to marine organisms. The same processes also play a major role in determining the behaviour of pollutants. Therefore the following section is as complete as possible in respect to published literature pertaining to our study area.

Dunbar's (1951) summary still stands as the most important overview of the physical oceanography of the Canadian eastern Arctic. However, major gaps in knowledge have since been filled to a certain extent by Bailey (1957) for the Archipelago, Collin (1962) for Lancaster Sound, Muench (1971, 1972) for northern Baffin Bay (including the 'North Water'), and others. Under-ice acoustic work (Milne 1960, 1964) is also included in this section.

- Bailey, W.B. 1956. On the origin of deep Baffin Bay water. J. Fish. Res. Bd. Canada 13:303-308.

This author has concluded from examination of temperature-salinity relationships that Baffin Bay deep water originates at approximately 250 m in the Arctic Ocean. The water flows through Smith Sound either in a very slow and continuous process or as a surge of heavy water and sinks to the bottom of Baffin Bay.

- Bailey, W.B. 1957. Oceanographic features of the Canadian Archipelago. J. Fish. Res. Bd. Canada 14:731-769.

This paper contains a short summary of pre-1957 oceanographic exploration; the most extensive was that by the Danish 'Godthaab' Expedition of 1928, which occupied 160 oceanographic stations in Baffin Bay, including the

entrances of Smith, Jones and Lancaster Sounds. The general aspects of water masses, circulation and physiography are described. Specific data from the cruise of the H.M.C.S. 'Labrador' in August and September 1954 are discussed in detail. The oceanographic sections across Lancaster Sound (2 sections), Navy Board Inlet, Baffin Bay, Barrow Strait and Wellington Channel are of particular interest. The reader is referred to the paper if details are required on the distribution of temperature, salinity and density in these sections.

A short summary of the general current patterns in the areas of concern as derived by Bailey from the slopes of the isopycnals is given below.

1. Lancaster Sound--westward current to a depth of 100 m flowing along the south coast of Devon; eastward flow through the entire Sound below 100 and 200 m levels and at the surface on the south side of the Sound extending to the centre.
2. Baffin Bay--strong, nearshore southward flow from Jones Sound.
3. Wellington Channel--water flows predominantly southward with strongest currents in the west side; flow into Lancaster Sound seems much stronger than that from Barrow Strait.

Bailey also discussed the existence of a patch of warm (6°C), high salinity ($32.2^{\circ}/_{\text{oo}}$) water at the eastern entrance to Lancaster Sound; this patch is apparently maintained by cyclonic circulation in that area.

The report also speculates about lateral mixing of waters around the eddy at the entrance to Lancaster Sound. If this occurs, there would be 'a renewal of surface waters through a very slow process of vertical mixing'. This speculated vertical mixing could be at least partly responsible for the transfer of nutrients from deeper water and could help explain the apparently very high productivity of Lancaster Sound.

This paper is a valuable review of the oceanographic conditions, as known previous to 1957, of the Canadian Archipelago. However, it is probably of limited use in an impact assessment statement because of the lack of detailed information on current direction and strength and year-to-year variability. This lack of detailed data, with few exceptions, continues to date.

- Barber, F.G. and A. Huyer. 1971. On the water of the Canadian Arctic Archipelago, an atlas presentation of 1961 and 1962 data. Canada Dept. of Energy, Mines and Resources Man. Rept. Series No. 21. 74 pp.

The atlas is based on temperature, salinity and oxygen data taken in 1961 by the 'Edisto', 'John A. MacDonald' and 'Labrador' and in 1962 by the 'John A. MacDonald', 'Labrador', land-based parties, and from ice camps. Horizontal distributions of temperature, salinity and oxygen are mapped for our study area and surrounding waters.

- Bilello, M.A. 1973. Prevailing wind directions in the Arctic Ocean. Cold Regions Research and Engineering Laboratory. Res. Rept. No. 306. 53 pp.

The following data are taken directly from the tables contained in this report. Clyde River on northeastern Baffin Island and Resolute Bay on Cornwallis Island were the only two stations that are located in the study area.

Mean Windspeed (mph) and Direction

	J	F	M	A	M	J	J	A	S	O	N	D	Year
<u>Clyde</u>													
Mean Speed	4.6	7.4	4.9	4.7	6.4	8.0	8.5	6.4	8.1	10.3	7.0	3.8	6.7
Prevailing Direction	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	
<u>Resolute</u>													
Mean Speed	11.9	11.5	10.4	10.9	11.6	12.6	12.1	12.3	12.5	12.5	11.0	10.4	11.6
Prevailing Direction	NW	E	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	

Wind speed and direction have a direct effect on the physical oceanography of an area and would play an important role in the behaviour and distribution of any pollutant. It is quite obvious that much more detailed information than the above would be needed for an impact study.

● Canadian Wildlife Service. 1976. Environmental baseline studies 1975 Strathcona Sound Program. Preliminary report prepared by B. Kemper (Ed.), S. Stephanson, and R. Schweinsburg. 96 pp.

The brief comments on the physical oceanography of Admiralty Inlet and Strathcona Sound are of some interest to this section of the review.

The surface water of Admiralty Inlet is assumed to originate from the west and the deeper water probably comes through Lancaster Sound from Baffin Bay. Currents in Admiralty Inlet are presumably weak with the flow generally southward on the west side and to the north on the east side. Ice movements indicated strong flow into Lancaster Sound from Admiralty Inlet. Surface currents in Strathcona Sound appear to exit on the north side.

- Collin, A.E. 1962. The oceanography of Lancaster Sound. Ph.D. Thesis, McGill University. 204 pp.

This thesis is a comprehensive synthesis of physical oceanographic data collected in Lancaster Sound and adjacent waters from 1956 to 1961. At the present time it is the main physical oceanographic study for Lancaster Sound and is the major source of information that is readily available in a form other than raw data. It is, however, a difficult thesis to critically evaluate, partly because of the scope of the thesis, but also because of the lack of detail on methods and the absence of appended data.

Collin reviews previous investigations from Sir John Ross in 1818 to acoustic work in 1961 by the Pacific Naval Laboratory in Barrow Strait. The geology, climate, bathymetry, ice conditions and general morphology of the Lancaster Sound area are described in detail.

The main portion of the thesis is devoted to temperature and salinity characteristics including vertical and horizontal profiles, currents and volume transport in the Lancaster Sound system (Lancaster Sound, Barrow Strait, Prince Regent Inlet, Wellington Channel, Peel Sound, Franklin Strait, Penny Strait). Concentrations of dissolved oxygen and inorganic phosphate were investigated to a very limited extent. This knowledge is of particular relevance to the biological oceanography of the area. The bulk of the data utilized in this report were taken on transects of standard oceanographic stations by the Canadian ice-breaker 'Labrador' during her 1956 and 1957 cruises (summer and early fall). The following table summarizes surface and bottom temperature and salinity averages for 1956 and 1957.

Depth (m)	Sept. 1956				Sept. 1957			
	North		South		North		South	
	°C	‰	°C	‰	°C	‰	°C	‰
<u>Eastern Lancaster Sound</u>								
0	-1.47	32.84	-1.33	32.37	0.85	31.73	0.50	31.29
500	0.41	34.41	0.56	34.42	0.37	34.41	0.50	34.38
<u>Barrow Strait</u>								
0	-1.79	31.31	-1.63	31.04	-0.74	29.28	-1.41	28.25
500	-	-	-1.37	33.01	-	-	-1.38	32.82
<u>Prince Regent Inlet</u>								
0	-1.52	30.06	-1.40	30.07	-0.44	28.73	1.36	29.94
250	-0.83	33.92	-0.93	33.68	-0.31	33.96	-1.31	33.35
<u>Wellington Channel</u>								
0	-	-	-	-	-1.44	32.01	-0.24	31.79
200	-	-	-	-	-1.61	33.07	-	-

Initial physical observations in Peel Sound and Franklin Strait indicate that subsurface temperatures range from -0.2° to -1.3°C and salinity ranges from $23.50^{\circ}/\text{‰}$ at the surface to $33.00^{\circ}/\text{‰}$ at 300 m. Average conditions in Penny Strait in 1957 were similar to those recorded in Wellington Channel. Observations in 1956 and 1957 were found to differ significantly. Water masses were analyzed by temperature-salinity diagrams. Baffin Bay water was found intruding as far west as Prince Regent Inlet (at all depths below 250 m) and in 1957 the influx was 22 percent greater in thickness than that recorded previously.

Collin calculated currents by examining the topography of the 26.5 sigma -t surface (26.5 sigma -t = surface of uniform density which was found throughout the study area) and the salinity distribution along this surface and by dynamic computation (using a 200 decibar reference level). Surface velocities in Lancaster Sound were calculated to be a maximum of 50 cm/sec at the eastern entrance decreasing to about 15 cm/sec at a depth of 100 m. The map (Figure a) shows the computed surface currents in Lancaster Sound.

The net flow of water through Lancaster Sound is eastward (0.49×10^6 m³/sec) but significant westward movement of Baffin Bay water into Lancaster Sound is common and occasionally predominates. Collin also suggests that there is significant volume transport to the south through Wellington Channel (0.90×10^6 m³/sec) and Prince Regent Inlet (0.51×10^6 m³/sec).

Collin presents a 'typical' oxygen profile for Lancaster Sound in the summer of 1956 with supersaturation and highest values at the surface (8.4 ml/l; 101 percent saturation), a secondary maximum at 20 m and a minimum at 100 m. The 1957 values are implausibly low (i.e. 5.0 ml/l at the surface) and must have been the result of technical difficulties.

Inorganic phosphate, an important nutrient, was investigated on a very limited scale (actual number of observations utilized not given) and displayed a minimum at 10 m (1.10 and 0.28 mg at/l averages for 1956 and 1957, respectively) and a maximum at 100 m (1.85 and 1.13 mg at/l averages for 1956 and 1957, respectively).

The following points can be made concerning this study and its relevance to the marine ecology of the area in question and to any future studies on the impact of oil development in the Lancaster Sound system.

1. Some care must be taken in using this study because of the lack of a methods section and appended data. Also it should be noted that current analysis was by theoretical computation and not by current meter.

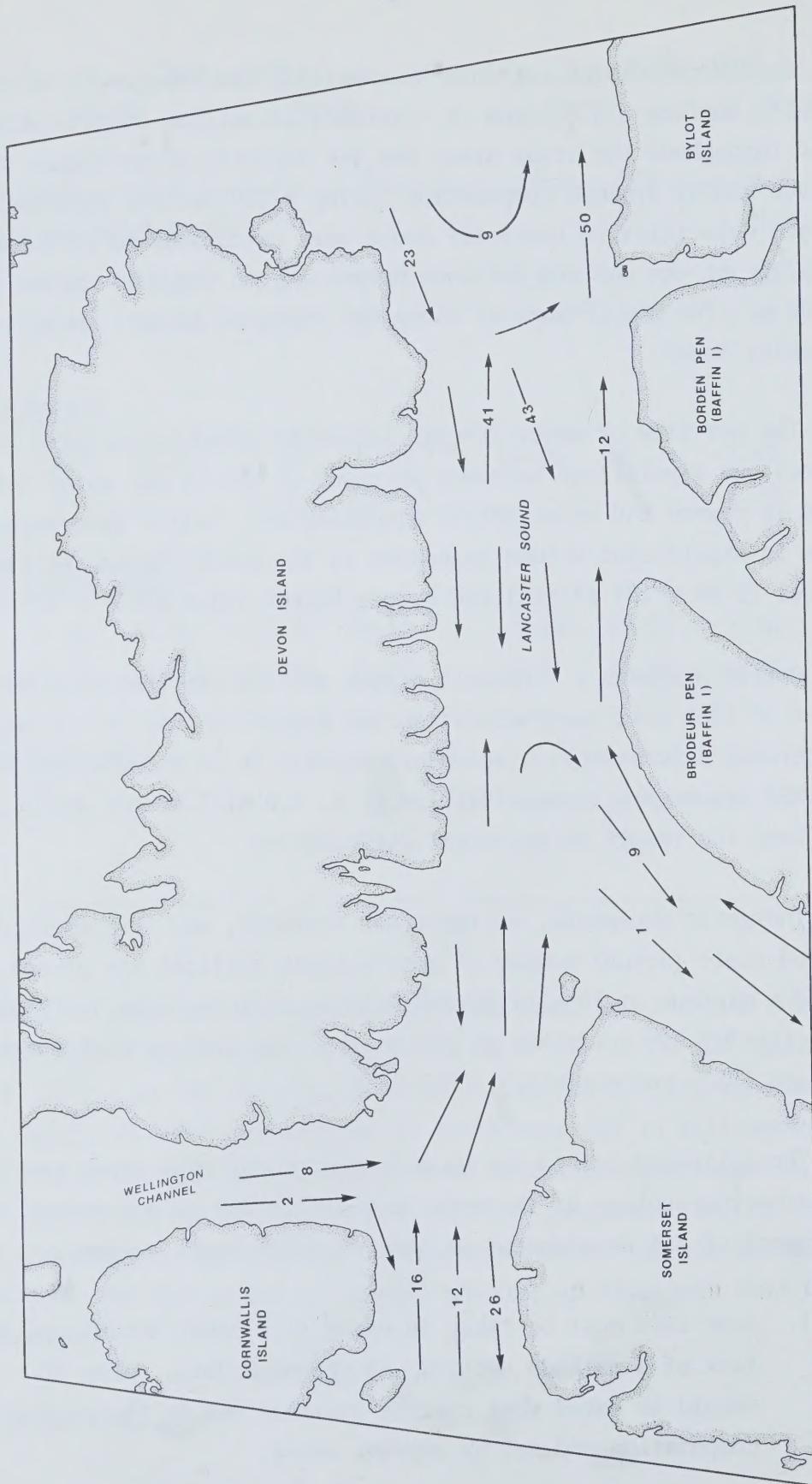


Figure a. Computed Surface Currents (cm/sec.) in Lancaster Sound (modified from Collin 1962).

2. The surface water of the system originates in the Arctic Ocean with most of the flow coming through Wellington Channel and Barrow Strait.
3. Below a depth of 250 m Baffin Bay water intrudes into Lancaster Sound, to a variable extent, and at least as far west as Prince Regent Inlet.
4. Generally, surface currents flow westward along the south side of Devon Island and eastward along the north side of Baffin Island; the strongest current (50 cm/sec) computed was flowing eastward along the north side of Bylot Island.
5. In Lancaster Sound, the physical environment, including surface currents and the influx of water from Baffin Bay, is variable from year to year as well as from season to season. This introduces additional problems to any ecological study of the area and added complexity to any impact prediction or assessment.

● Collin, A.E. and M.J. Dunbar. 1964. Physical oceanography in Arctic Canada. *Oceanogr. Mar. Biol. Ann. Rev.* 2:45-75.

This is a valuable summary paper of physical oceanographic work in the Canadian Arctic. However, for the area of our prime concern the authors have relied heavily on Dunbar (1946a, 1951), Bailey (1956, 1957) and Collin (1962). The reader is referred to the reviews of these papers for relevant details.

- Dunbar, M.J. 1946a. The state of the West Greenland Current up to 1944. J. Fish. Res. Bd. Canada 6:460-471.

The following is the author's abstract.

'Temperature records from the mouth of Godthaab fjord, west Greenland, during 1942-1944, show a cooling of the water over three years, particularly marked in the first half of the year. The temperature history of the west Greenland current is traced by means of available records since 1883. It is found that warmer conditions existed during the decade of 1880, followed by a colder period up to about 1920, when the present warm period began. The peak of the present warm period appears to have been reached in the middle 1930's, and it is possible that the cycle is about to return to colder conditions, with a weakening of the Atlantic component of the currents.'

The above, in itself, is probably of negligible interest to any impact assessment, particularly since the Canadian Arctic should be less affected by these long-term changes than West Greenland according to Dunbar (1951). However, this report does emphasize the need for either an understanding of long-term changes or, at the least, recent physical and biological data before the nature of any type of environmental damage could be predicted.

- Dunbar, M.J. 1951. Eastern Arctic Waters. Bull. Fish. Res. Bd. Canada No. 88. 131 pp.

This classic work is a detailed review of exploration and oceanographic expeditions and the pre-1951 state of knowledge of the physical oceanography of the Canadian eastern Arctic. It includes data on bathymetry, water masses, temperature and salinity distributions, water circulation, the

dynamics of fiords and inlets including glacial upwelling, seasonal cycles and long-term changes in physical oceanographic processes. Dunbar has suggested a delimitation of Arctic and Subarctic marine environments and points out gaps in knowledge, many of which exist to this date--particularly the lack of data on seasonal and long-term variability in hydrographic conditions.

Information to the west of the eastern end of Lancaster Sound and to the north of Hudson Bay was very scanty or non existent at the time of this publication. Dunbar relied heavily on Kiilerich (1939), who had shown that Baffin Bay water enters Lancaster Sound along the northern side and also by a subsurface mid-sound current. Both currents extended down to 600 m and exhibited a velocity on the order of 2 cm/sec at a depth of 500 m.

The greatest contribution of Arctic water into Baffin Bay is made through Lancaster Sound and the following estimates are from Kiilerich (1939).

Lancaster Sound	55 km ³ /day
Jones Sound	25 km ³ /day
Smith Sound	35 km ³ /day

Dunbar discussed the 'North Water', where Kiilerich (1939) had proposed that open water in winter is the result of vertical exchange caused by denser winter Arctic water sinking. Dunbar proposed that the same mechanism is probably responsible for maintenance of open water in eastern Lancaster Sound.

Fiords and inlets, primarily in West Greenland, are discussed. Moffet Inlet, a tributary bay of Admiralty Inlet, is identified as an exception to the rule of surface outflow in fiords and inlets.

The following figures are of some relevance to future environmental impact studies. Figure a is composed of 5 temperature-salinity polygons

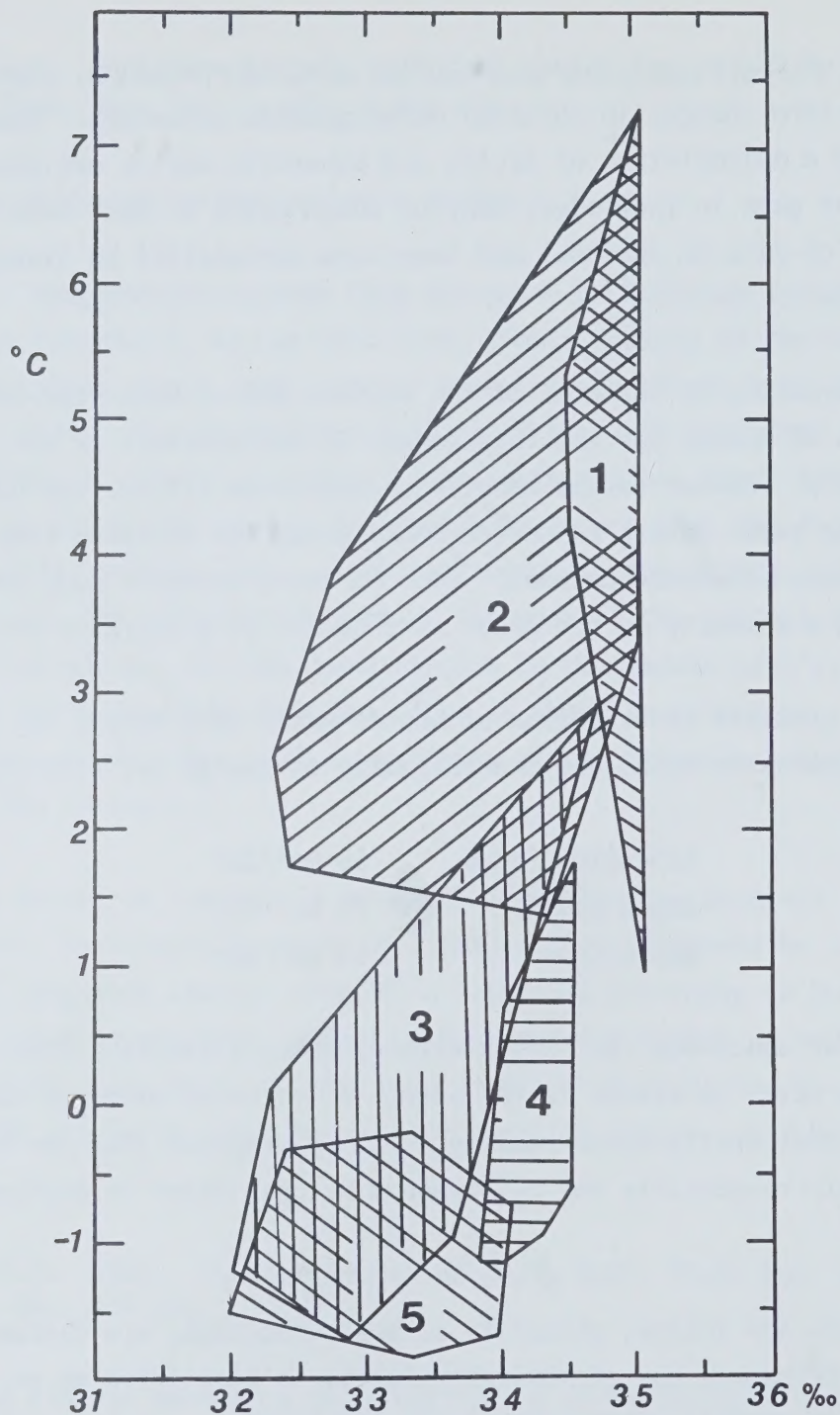


Figure a. Temperature-salinity diagram showing the water masses of the eastern Arctic. Water from the surface to 50 m is omitted.

1. Labrador Sea
2. West Greenland, Disko to Cape Farewell
3. Labrador current
4. Deep Baffin Bay water, from 300 m to bottom
5. Polar water, from (a) Smith Sound, Jones Sound, Lancaster Sound, from 200-250 m to 50 m. (b) Baffin Bay, 250 m to 50 m, and all depths in the Canadian current. (c) Hudson Bay (Haida stations, 1948).

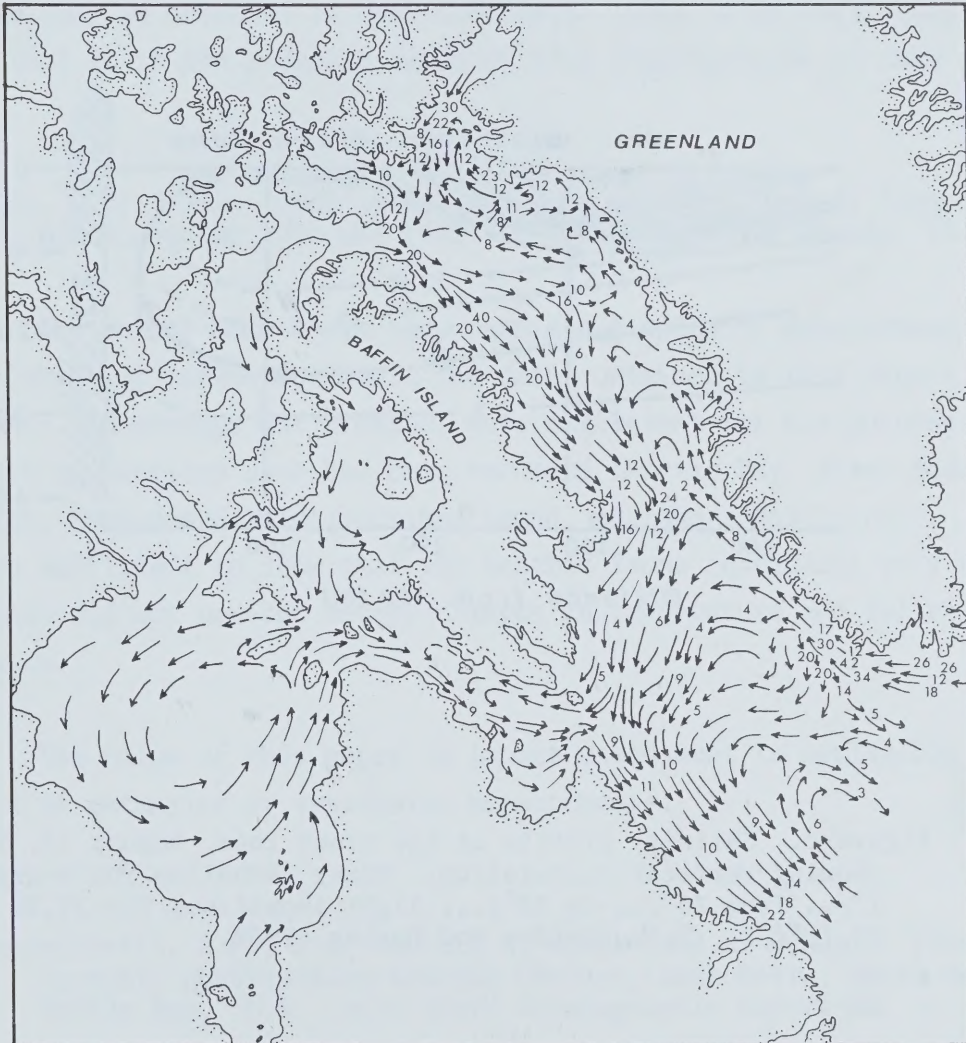


Figure b. Surface currents, Aug-Sept. Circulation in Baffin Bay, Davis Strait and the Labrador Sea (including the Labrador and W Greenland currents) is taken from Kiilerich (1939). The Baffin current is plotted according to the 'Northland' (1940) results (Hawley, Smith, Barnes and Soule, 1940). The Hudson Bay and Hudson Strait circulation is plotted from various sources, including Hachey (1931b, 1935). Ungava Bay from the author's observations in 1947. (Figures are surface velocities in cm/sec.).

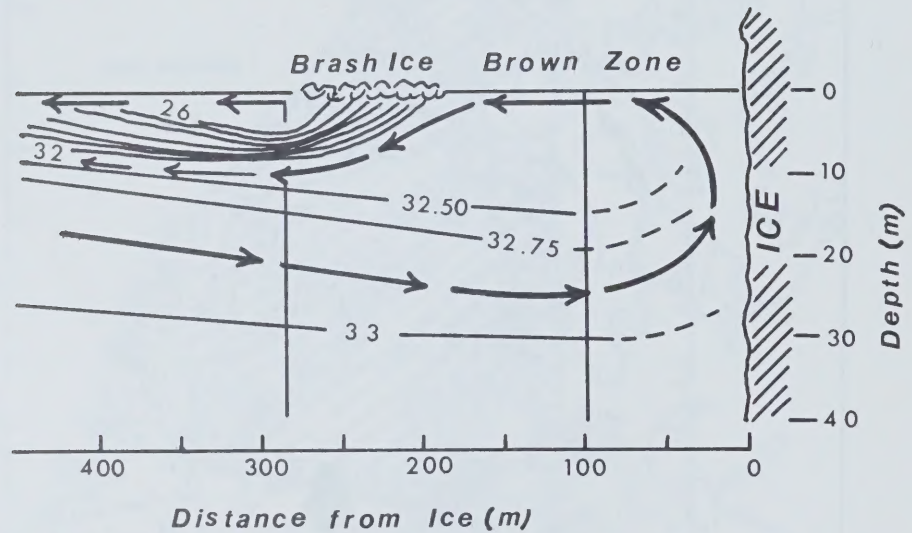


Figure c. Salinity profile at Ege brown zone, August 22, 1936, showing vertical circulation. Heavy isohaline for every 1‰ from 26‰ to 33‰; light isohalines for 32.50 and 32.75‰. From Hartley and Dunbar, 1938.

that show the water masses of the eastern Arctic. Figure b shows surface currents and velocities of the area as known prior to 1951. These, of course, are of obvious short-term interest in the event of an oil spill or blowout in this area. However, in the long term, it should be noted that Dunbar has also postulated the existence of a subsurface feedback mechanism in Baffin Bay. Figure c illustrates the mechanism of glacial upwelling as observed in West Greenland. This is of particular significance in that it is the probable cause of bird congregations in such areas.

- Ellis, D.V. 1956a. Some temperature and salinity records from the Canadian Arctic during 1954 and 1955. J. Fish. Res. Bd. Canada 13:591-598.

The author made a few temperature and salinity measurements to augment his study of marine benthos. The data contained in this report, though scanty and perhaps not precise, were sufficient for his purposes in areas where no previous data had been recorded (Arctic Bay, Adams Sound, Admiralty Inlet, Navy Board Inlet, Eclipse Sound, nearshore Baffin Bay). The data were sufficient to show that the benthic fauna (excluding very nearshore fauna) did not undergo severe changes in temperature and salinity with season.

The value of this paper in impact assessment is negligible due to the lack of extensive or systematic measurements.

- Franceschetti, A.P., D.A. McGill, N. Corwin and E. Uchupi. 1964. Oceanographic observations Kennedy Channel, Kane Basin, Smith Sound and Baffin Bay. U.S. Coast Guard Oceanographic Report No. 5. 98 pp.

Data on temperature, salinity, oxygen and nutrients (inorganic phosphate, total phosphorus, nitrate, nitrite, silicate) are presented--mainly graphically and in tables. Sediments and topography of Kane Basin are also described. Minimal interpretation is given and the stations were all considerably north of our study area.

- Kiilerich, A.B. 1939. The Godthaab Expedition 1928. A theoretical treatment of the hydrographical observation material. Medd. Grønland 78(5):1-149.

The relevant sections of this paper are considered in the review of Dunbar's 1951 summary of previous oceanographic effort in the Canadian Eastern Arctic. The paper contains details of the calculations of surface circulation and water transport based on the extensive physical data collected by the 'Godthaab' Expedition in Baffin Bay and the eastern entrances to Jones and Lancaster Sounds. It should be emphasized that the conclusions are based on the dynamic topographic method rather than direct measurements of currents, and this method '... has certain limitations which might appear more vividly to the biologist than to the physical oceanographer, and the present author reserves the right to temper his admiration of the method with a little suspicion' (from Dunbar 1951).

- McCann, S.B. and R.B. Taylor. 1975. Beach freeze-up sequence at Radstock Bay, Devon Island, Arctic Canada. Arctic and Alpine Res. 7:379-386.

The 1971 beach freeze-up process in Radstock Bay, south Devon Island, is described. The following three phases are discussed and are applicable to a normal year and probably to other similar locations within our study area.

Phase 1--mean daily temperature falls consistently below 0°C ; saltwater begins to freeze in the intertidal zone; usually occurs during the first few days of September.

Phase 2--mean daily temperature falls below -2.2°C ; snow, slush and brash ice build up; a thick glaze of ice may build up across the beach; severe storms may alter the beach profile, ground pack-ice, and deposit brash ice above the intertidal zone.

Phase 3--preceded by several days of temperatures consistently below -6°C ; termination of freeze-up; in 1971 this occurred on the 4th of October.

The exact timing of the above phases is variable and dependent on temperature, wind and wave conditions and ice pack conditions.

- Milne, A.R. 1960. Shallow water under-ice acoustics in Barrow Strait. J. Acoustical Soc. Amer. 32:1008-1016.
- Milne, A.R. 1964. Ambient noise under Arctic-sea ice. J. Acoustical Soc. Amer. 36:855-863.

These two papers could be of considerable importance if underwater noise pollution with its attendant effects on marine mammals is included in any impact assessment or prediction study.

The 1960 paper investigated explosive sound propagation under young 7-ft-thick fast-ice in Barrow Strait. Ambient noise was investigated at one location and found to be quite low. The 1964 study investigated under-ice ambient noise much more intensively during the spring, summer, and winter of 1963. Although this second study was conducted to the west of our study area (M'Clure Strait and at two locations just west of Ellef Ringnes Island), the conclusions have general relevance. Background noise levels were found to be quite high, extremely variable, and caused mainly by mechanical ice activity.

- Muench, R.D. 1971. The physical oceanography of the northern Baffin Bay region. Baffin Bay - North Water Project Sci. Rept. No. 1, Arctic Institute of North America, Washington, D.C. 150 pp.

This is the most comprehensive report available on the physical oceanography of northern Baffin Bay. Oceanographic data from 1916 to 1969 were

utilized although relatively complete geographical data were obtained only in 1928, 1960 to 1964 and 1966.

The author's summary and conclusions follow.

1. 'The waters of Baffin Bay may be divided, on the basis of their vertical temperature distribution, into three layers. The characteristics of this structure have remained unchanged from 1928 to 1966. The layers are:

- a) 'An upper layer of relatively cold (0°C to 1.8°C), low salinity ($<31^{\circ}/\text{oo}$ to about $34.4^{\circ}/\text{oo}$) Arctic Water. This extends from the surface down to 100-150 m in northeastern Baffin Bay, to 200-300 m in northwestern Baffin Bay and Lancaster Sound, and to the bottom in Smith and Jones sounds. Minimum temperatures in a prominent cold core occur in northeastern and north central Baffin Bay; the core is a consequence of winter thermohaline convection within Baffin Bay. A shallower and less pronounced core in northwestern Baffin Bay, Smith, Jones and Lancaster sounds is a remnant of the winter convective layer in the Arctic Ocean.

'Arctic Water is water of Atlantic Ocean origin which either entered Baffin Bay via Davis Strait and was modified by cooling and admixture of runoff within northern Baffin Bay, or was modified by cooling and freshening within the Arctic Ocean prior to entering Baffin Bay from the north.

- b) 'An intermediate layer of warmer (0°C to $>2^{\circ}\text{C}$), more saline ($34.2^{\circ}/\text{oo}$ to $34.5^{\circ}/\text{oo}$) Atlantic Water. This extends from the bottom of the Arctic Water layer down to 1200-1300 m in northern Baffin Bay proper, down to

600-700 m in Lancaster Sound, and is absent from Smith and Jones sounds. Maximum temperatures occur within a pronounced warm core in this layer.

'The Atlantic Water originates from the Atlantic Ocean via Davis Strait, from whence it is advected northward by the West Greenland Current while losing heat due to mixing with Arctic Water. Relatively shallow sill depths between Baffin Bay and the Arctic Ocean prevent a southward flow of Arctic Ocean Atlantic Water.

- c) 'A deep layer of relatively cold (0°C to -0.4°C) Deep Water, including water below 1800 m of extremely uniform temperature (-0.40°C) and salinity ($34.48^{\circ}/\text{oo}$); the Bottom Water. The Deep Water is characterized by a temperature decrease and nearly uniform salinity as the depth increases to 1800 m. Horizontal temperature and salinity variations, if any, are undetectable.

'The Deep Water is identical to water occurring at 200-250 m depth in the Eurasian Basin of the Arctic Ocean. Water of proper type to contribute to Deep Water only above about 1400 m depth occurs commonly in Nares Strait, however. Deep Water below 1400 m, including Bottom Water, is suspected to originate from the Arctic Ocean as irregular pulses; however, these have never been observed. It is improbable that winter thermohaline convection within Baffin Bay contributes to the Deep Water.

2. 'The southern Smith Sound, Jones and Lancaster Sound regions are sites of mixing between inflowing Arctic Ocean Water and Baffin Bay Arctic Water of the same density. The major proportion of the Arctic Ocean Water is less dense than Baffin Bay Water, however, and therefore flows over it. The resulting near-surface layer of Arctic Water of Arctic Ocean

origin occurs primarily in northwestern Baffin Bay, where it is advected southward by the Baffin Current. Its presence produces a prominent downward slope, to the west, of the isohalines.

'Mixing between Baffin Bay Atlantic Water and inflowing Arctic Ocean Water occurs primarily in the southern Smith Sound region. Of the three channels entering northern Baffin Bay, only Smith Sound has sufficiently deep access to the Arctic Ocean to allow southward flow of Arctic Ocean Water dense enough to occur at the same depth as and therefore mix with Baffin Bay Atlantic Water. This mixing, coupled with irregular flow through Nares Strait, contributes to an irregular temperature distribution in the southern Smith Sound region.

3. 'The net computed (baroclinic) transport through northern Baffin Bay is $2.0 \pm 0.7 \times 10^6 \text{ m}^3/\text{sec}$ southward. Approximately twice as much inflow into Baffin Bay occurs through Lancaster Sound as through Smith or Jones sounds. Surface flow reversals have been observed in Smith Sound, while reversals of baroclinic flow have occurred in both Smith and Jones sounds.

'It was impossible to obtain a volume transport balance by geostrophic calculations. This was felt to be due primarily to time variations coupled with the non-synopticity of oceanographic data; the neglect of barotropic currents inherent in the dynamic method may also have been a contributing factor.

'The net southward transport through northern Baffin Bay appears to be driven by a higher surface elevation in the Arctic Ocean than in Baffin Bay; this difference is due to differences in water structure between the upper 250 m

layers of the Arctic Ocean and Baffin Bay. Atmospheric pressure disturbances may be sufficient to cause flow reversals in Nares Strait.

4. 'The baroclinic flow pattern within northern Baffin Bay consists of the northward West Greenland Current in its eastern part; the southward Baffin Current in its western part; and a cyclonic gyre east of Devon Island. Cyclonic circulation of Baffin Bay Water occurs in southern Smith Sound and in eastern Jones and Lancaster sounds. The West Greenland Current transports northward only about 10% of the volume transported southward by the Baffin Current, and is not always present during the late summer.

'The cyclonic circulation within northern Baffin Bay is driven by a combination of winds and baroclinic fields resulting from low-salinity near-shore wedges due to melt-water admixture. Both the baroclinic field due to the presence of less dense Arctic Ocean Water and westward intensification processes appear to be important in the dynamics of the Baffin Current.

'Bottom topography exerts some control on the currents in Lancaster Sound and off Cape York. This control, coupled with the temperature distribution in the Atlantic Water, suggests that the currents extend nearly to the bottom there. Year-to-year variations, including formation of eddies and gyres, may also occur in Lancaster Sound and off Cape York.

5. 'Seasonal variations in the water structure include winter development of a cold, uniform near-surface layer due to freezing which becomes isolated during the summer by a warmed surface layer, leaving a cold core beneath. Summer meltwater addition in Nares Strait and west of

Jones and Lancaster sounds causes freshening, relative to winter salinities, down to deeper than 100 m.

'Seasonal circulation variations are uncertain. An approximate doubling of wind stress, with quadrupling of the wind stress curl, occurs during the winter; lack of knowledge of vertical stress transfer through pack-ice precludes, however, a quantitative estimate of the winter wind-driven currents. The absence, during the winter, of near-shore low salinity wedges due to meltwater admixture might result in diminution or absence of the West Greenland Current. No appreciable changes would be expected in the net southward flow through the system, because the same processes affecting density in the upper 250 m occur both in Baffin Bay and in the Arctic Ocean.

6. 'The North Water is a large, semi-permanent polynia which occurs regularly throughout the winter in the northern Baffin Bay-Smith Sound region. The extent of this open water has been roughly documented only for the March-June period; after June it loses its identity due to the eastern Arctic melt. Year-to-year variations in the open water area are as large as monthly variations during a given year, which contribute to difficulties in determining its exact extent.

'Computations using summer oceanographic data suggest that insufficient heat is available in the Atlantic Water layer in northern Baffin Bay to prevent ice formation in the North Water. A probable winter decrease in the transport of the West Greenland Current would further decrease the available heat. Mechanical processes of ice removal must therefore be primarily responsible for the formation and maintenance of the North Water.

'While overall summer conditions have remained constant, the northern Baffin Bay region is characterized by a high degree of time variability in its circulation and hydrographic structure details. It is therefore possible at this time to depict these features on only a gross scale.

'Further summer oceanographic exploration in northern Baffin Bay will yield little new information. Combined winter oceanographic and meteorological sampling would, however, increase overall understanding of the circulation and hydrography.'

Figures a-c are maps taken directly from the text and give some idea of the directions of computed surface currents, their variability, and the occurrence of eddies within our study area.

The following table is a synthesis of the discussion comparing computed volume transports through Lancaster Sound:

<u>Author</u>	<u>Reference Level</u>	<u>Net Transport ($\times 10^6$ m³/sec)</u>	<u>Direction</u>
Kiilerich (1939)	1000 db	0.65	East
Collin (1963)	500 db	1.0	East
Palfrey and Day (1968)	700 db	0.45*	West*
		0.68*	East*
		0.45**	East
Recalculation of Palfrey and Day data	500 db(?)	0.3	East
		0.6	East

*Palfrey and Day (1968) attributed these gross differences to tidal fluctuation. Muench (1971), however, thought that internal waves would be a more likely cause.

**Palfrey and Day (1968) assume this value for net transport into Baffin Bay from Lancaster Sound.

The inconsistencies in the data are probably caused by slight differences in methodology (i.e. different reference levels), different locations of observations, and perhaps year-to-year variability. More exact estimates will not be available until direct current measurements are made.

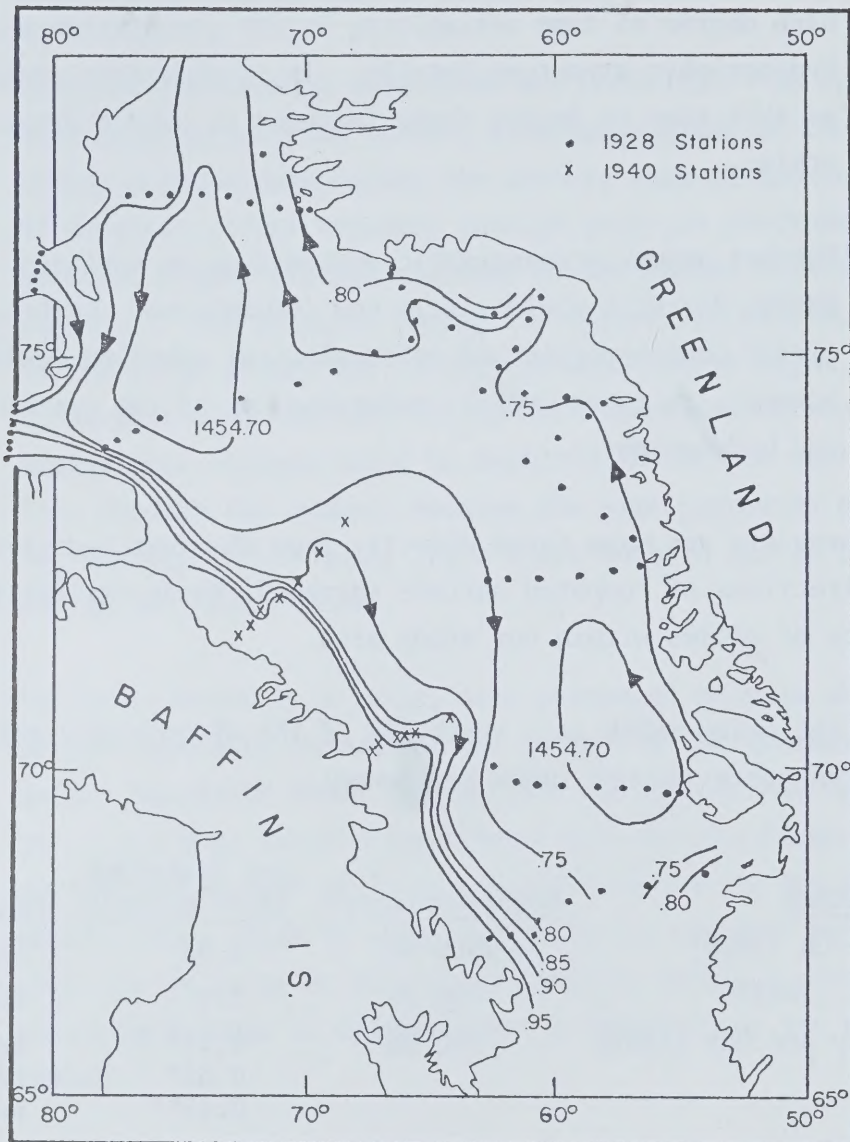


Figure a. Dynamic topography of the surface with respect to 1500 db (from Barnes 1941). Contour interval is 0.05 dyn. m.

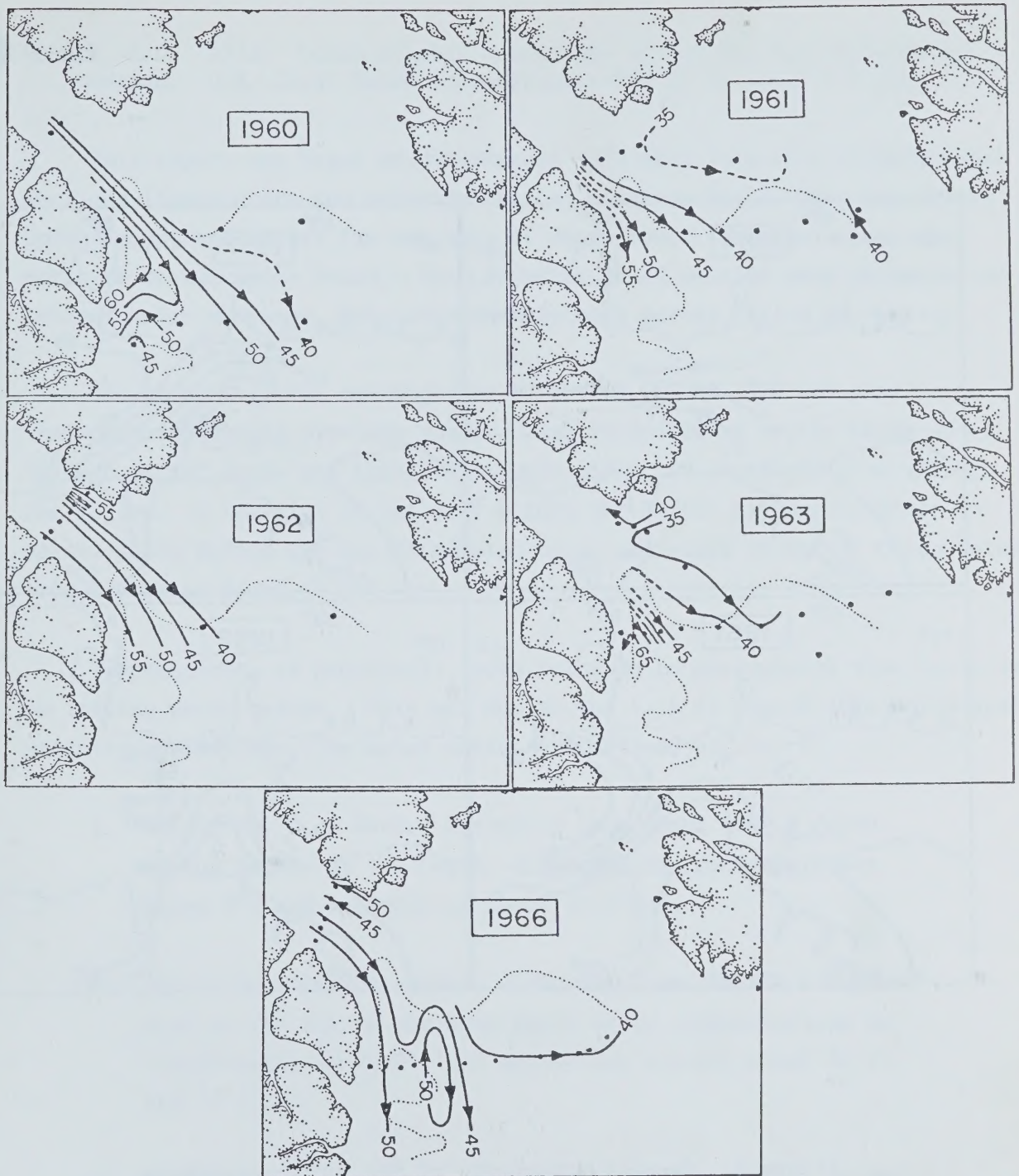


Figure b. Dynamic topography of the surface relative to 500 db in northern Baffin Bay, with a contour interval of 5 dyn. cm. The dotted line indicates the 800 m isobath.

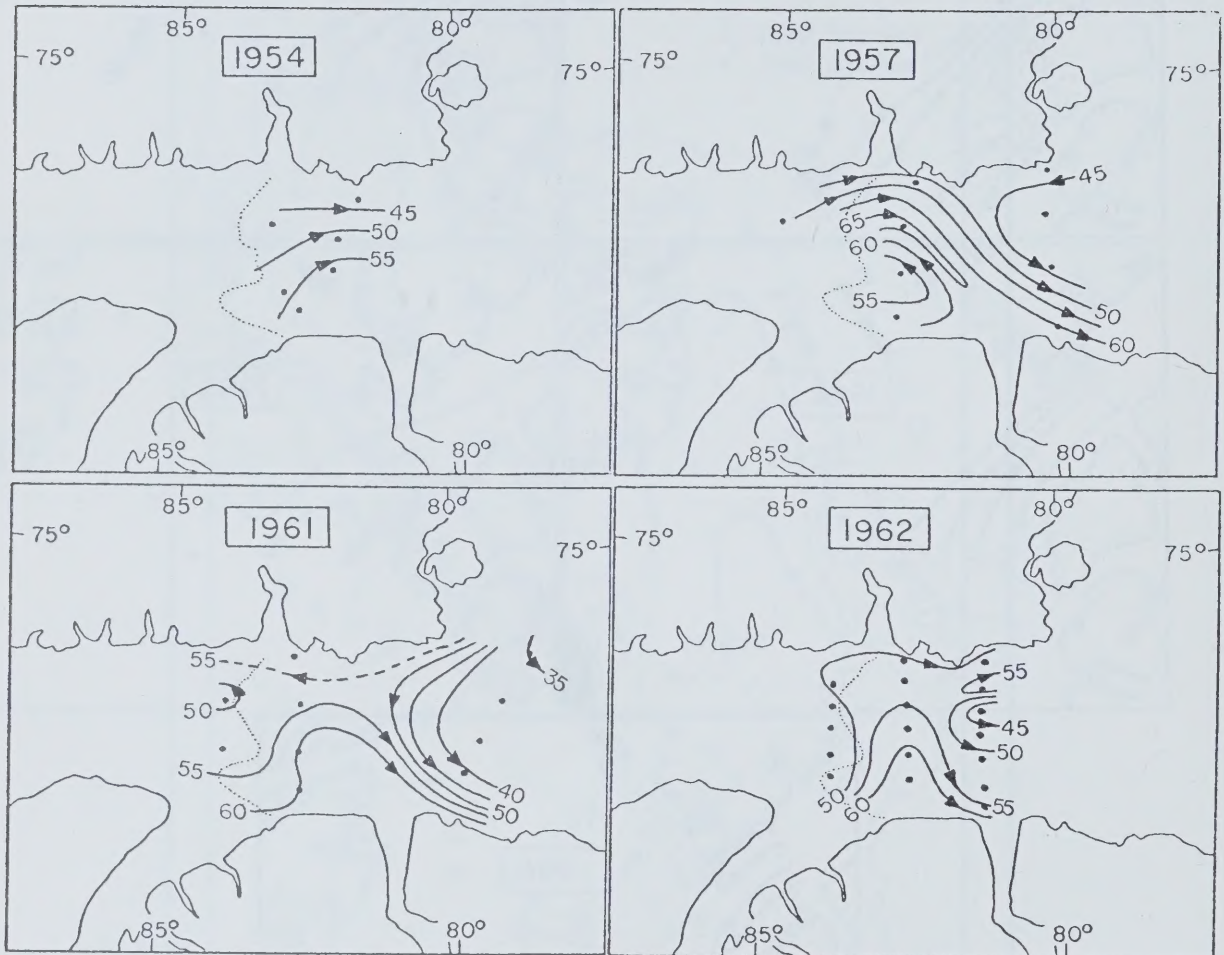


Figure c. Dynamic topography of the surface relative to 500 db in Lancaster Sound for various years, with a contour interval of 5 dyn. cm. Dotted line is the 650 m isobath.

● Muench, R.D. 1972. Oceanographic conditions in the northern Baffin Bay region. U.S. Coast Guard Oceanographic Report No. 54. 113 pp.

This report was based on July-August 1970 data from five oceanographic sections (temperature and salinity) across northern Baffin Bay, one across Smith Sound, one across the entrance of Jones Sound, and one across the entrance of Lancaster Sound. The Lancaster Sound section also included two current meter moorings, but unfortunately both meters failed to operate.

The gross physical oceanography of the region in 1970 was similar to that observed during previous summers with an inflow of Arctic Ocean water through Smith, Jones and Lancaster Sounds and a net southward flow through the region. A lowering of salinity within the Baffin Bay Arctic Water in northwestern Baffin Bay was attributed to an admixture of Arctic Ocean water from Lancaster Sound.

Temperatures, as previously, were found to be more useful than salinity in tracing water masses. This was due to the lack of appreciable horizontal salinity variations. The water masses are defined as

1. Baffin Bay Deep Water, extending from about 1400 m depth to the bottom of the basin, characterized by temperature below 0°C and salinity of about $34.5^{\circ}/\text{‰}$.
2. Baffin Bay Atlantic Water, extending from 100-300 m depths down to the top of the Deep Water layer, characterized by temperatures above 0°C and salinities between about 34.2 and $34.5^{\circ}/\text{‰}$.
3. Baffin Bay Arctic Water, extending from the surface to the top of the Atlantic Water layer, characterized by temperatures below 0°C (except near the surface, where higher temperatures may occur locally due to warming from above), and salinity values from less than $31^{\circ}/\text{‰}$ to about $34.4^{\circ}/\text{‰}$.

Temperatures in Smith and Jones Sounds were below 0°C throughout the water column. The cold core ($<1.5^{\circ}\text{C}$, 100-150 m depth) was thicker in the southern part of northern Baffin Bay and Lancaster Sound than farther north.

The warm lens ($>4^{\circ}\text{C}$), noted previously by Muench and others, was located at the surface east of Devon Island and presumed to be caused by solar insolation.

Water warmer than 0°C was encountered at the entrance to Lancaster Sound below about 200 m. However, near the south side of the Sound the 0°C isotherm was encountered much deeper (350-400 m).

Distributions (vertical and horizontal) of temperature and salinity, temperature and salinity envelopes, and data tables are presented in this report.

- Palfrey, K.M. Jr. and G.G. Day. 1968. Oceanography of Baffin Bay and Nares Strait in the summer of 1966 and current measurements in Smith Sound 1963. U.S. Coast Guard Oceanographic Report No. 16. 204 pp.

This report contains a discussion of the physical oceanography of Baffin Bay in the summer of 1966 as well as extensive diagrams on temperature, salinity, mass transport, etc. and data tables. Data are based on oceanographic sections made by USCG 'Edisto' across Baffin Bay, Nares Strait, Jones Sound and Lancaster Sound. Temperature and salinity characteristics and water masses were not significantly different than those determined by other workers and thus will not be discussed further. In Lancaster Sound, one section from Navy Board Inlet to Cape Warrender was occupied twice at different phases of the tidal cycle. Current meter measurements in Smith Sound were quite limited because of equipment failures. The reader is referred to the report for specific details.

The following conclusions are of some relevance to environmental impact studies.

1. The oceanographic conditions in Lancaster Sound are complex and seem to be greatly influenced by tidal effects.
2. The strong westward-flowing current in northern Lancaster Sound is very near shore, at least in the vicinity of Cape Warrender. Its speed was computed as 27 cm/sec.
3. Lancaster Sound water contributes significantly to the Baffin Current.
4. A rough estimate of volume transport through Lancaster Sound is $0.45 \times 10^6 \text{ m}^3/\text{sec}$, which is roughly 50% of the inflow into Baffin Bay. In comparison, Jones Sound and Smith Sound contribute approximately 25% each. The percentages do not differ significantly from Kiilerich (1939) but the volume transport does (see review of Muench 1971 for comparisons).

● Peck, G.S. 1977. Oceanographic observations: Penny Strait N.W.T., April 1976. Unpublished manuscript submitted to Polar Continental Shelf Project Annual Report. 4 pp.

Temperature and salinity data were obtained along a transect of six stations across Penny Strait from Cape Sir John Franklin to Cape Kitson. These stations were occupied four times from 20-22 April. One transect of six stations was completed across Belcher Channel on 24 April. Surface currents were measured at two locations (13 hour observations)--one in mid-strait and one approximately 8 km to the northeast.

In Penny Strait temperatures increased from about -1.80°C at 2 m to about -0.70°C between 200 and 275 m. Salinities ranged from $31.26^{\circ}/\text{oo}$ at the surface to $32.94^{\circ}/\text{oo}$ at 200 m. Mean flow was generally to the south-east as determined by geostrophic methods; however, the current meters noted some deflection (probably the result of local bathymetry) of mean flow to the south-southwest. Maximum surface currents of 50-65 cm/sec were recorded.

This report is preliminary to a more detailed manuscript, which should be available in the spring of 1977 or shortly thereafter. This more detailed report will include analyses and interpretation of results and should be of value in quantifying water flow into Wellington Channel--an area of more immediate interest to the present review.

NUTRIENTS

The three papers in this section deal exclusively with nutrients and possible sources of nutrient enrichment. Additional nutrient data, including information about concentrations in specific areas, is included in certain of the studies reviewed in the 'Interdisciplinary Studies' and 'Primary Production' sections.

- Apollonio, S. 1973. Glaciers and nutrients in Arctic seas. *Science* 180:491-493.

The study was conducted in glaciated South Cape Fiord, unglaciated Grise Fiord, and adjacent Jones Sound. It is reviewed here because of the total lack of this type of study in the Lancaster Sound area.

The upper 75 m of South Cape Fiord had significantly higher nitrate concentrations and higher average silicate concentrations than the upper 75 m of Grise Fiord and Jones Sound. No significant difference was found in phosphate levels. In the euphotic zone (the upper 25 m) nitrate concentrations averaged 18% higher in South Cape Fiord than in Grise Fiord. Nitrates and, to a lesser extent, silicates were found to be the limiting nutrients in Jones Sound.

Apollonio attributed the nutrient enhancement of South Cape Fiord to glacial erosion of limestone. Dunbar in a slightly later paper (see Dunbar 1973 in this review) suggested that the glacial enrichment was more due to upwelling at the glacial face rather than any erosive effects.

● Codispoti, L.A. and T.G. Owens. 1975. Nutrient transports through Lancaster Sound in relation to the Arctic Ocean's reactive silicate budget and the outflow of Bering Strait waters. *Limnol. Oceanogr.* 20:115-119.

This study is based on data from a 1973 oceanographic section (5 stations) across western Lancaster Sound from the northeastern coast of Somerset Island to the southwestern coast of Devon Island. Data from the National Oceanographic Data Center and the Canadian Oceanographic Data Center were also utilized. Samples were analyzed for nitrate, nitrite, reactive phosphorus, reactive silicate and ammonia. Only reactive silicate and to a lesser degree reactive phosphorus are discussed in this paper.

The authors have designed a reactive silicate budget for the Arctic Ocean and come to the conclusion that Lancaster Sound is enriched by Bering Strait waters. Tentative estimates of the proportion of Bering Strait waters are given. This in itself has little ecological significance or relevance to impact studies. However, the study does give some gross indication of the levels of two important phytoplankton nutrients in western Lancaster Sound (presumably in the summer--no date given). The following conclusions are drawn from the only two figures on nutrient distributions.

1. Reactive silicate-silicon (mg atoms/l) increased progressively from about 5 at 25 m to 20 at 50 m with highest values (25-27) encountered on the south side of the channel below 100 m. In contrast, below 100 m on the north side values were around 20.
2. Reactive phosphorus (mg atoms/l) increased from about 0.5 at the surface to approximately 1.5 between 50 and 100 m. Highest values (2.0) were encountered on the south side below 100 m.

- Dunbar, M.J. 1973. Glaciers and nutrients in Arctic fiords. *Science* 182:398.

Dunbar states that nutrient enrichment in a glacial fiord, which has been reported by Apollonio (1973) (this review), was due to upwelling at the glaciers' sea-face rather than to any erosive effect. The much shallower South Cape Fiord (glaciated) contained nitrate concentrations in deeper water equivalent to those at the same depths in Grise Fiord (unglaciated). Thus the higher levels of nitrate found in the upper layers of South Cape Fiord are probably due to glacier- and iceberg-induced upwelling. This type of upwelling had been previously documented in a West Greenland fiord by Hartley and Dunbar (1938).

PRIMARY PRODUCTION

Only two studies of primary production have been conducted in the present study area (Apollonio 1956; Welch and Kalff 1975). Therefore, other studies have been included in this section. The Jones Sound studies (Apollonio 1965, 1976b) are of particular interest. Detailed nutrient concentration data are also included in these reports. The annual primary production values of Petersen (1964) for Denmark and South Greenland are given for comparison purposes.

- Apollonio, S. 1956. Plankton productivity studies in Allen Bay, Cornwallis Island, N.W.T., 1956. Woods Hole Oceanographic Inst. Unpubl. Manuscript. 8 pp.

Allen Bay was sampled at regular depths to a maximum of 25 m for phytoplankton, chlorophyll, dissolved oxygen and inorganic phosphate during the summer of 1956 (18 July to 28 August). Light penetration was measured by Secchi disk. Some temperature and salinity measurements were also obtained.

Chlorophyll

Chlorophyll was frequently undetectable at the surface. Concentrations ranged from near 0 to 5.45 mg/m³ (recorded at 6 m). Average concentration was 1.08 mg/m³.

Production

Production was estimated from chlorophyll concentrations and ranged from 0.02 to 0.69g C/m²/day. Average production for the summer was 0.192g C/m²/day.

Nutrients

Inorganic phosphate concentrations near the surface increased to a

peak of 0.40 μg at $\text{PO}_4/1$ on 12 August and then declined. The near bottom samples exhibited a continuous decline throughout the summer from 0.90 μg at/1 to 0.33 μg at/1.

Total phosphorous concentrations (5 m to 25 m) ranged from 0.15 μg at/ to 2.03 μg at/1 but were generally close to 1.0 μg at/1.

Dissolved Oxygen

Percent saturation ranged from 70% at 2 m and 10 m on 26 July to 134% at 5 m on 5 August. After this date values generally exceeded 105% saturation.

Temperature and Salinity

Stratification was considerably reduced after break-up of the inner bay on 7 August.

Conclusions

1. Chlorophyll concentrations were equivalent to summer values in Scoresby Sound, E Greenland.
2. Allen Bay appears to be much richer in phosphate than the E Greenland Current.
3. Phosphate is probably not a limiting nutrient in Allen Bay.

● Apollonio, S. 1965. Chlorophyll in Arctic sea ice. Arctic 18:118-122.

Although conducted in Jones Sound outside the geographic scope of the present review, this study is mentioned because of the general lack of sea-ice chlorophyll studies in the Canadian Archipelago.

Apollonio found that in 1961-63 nearshore sea-ice generally contained higher concentrations of chlorophyll *a* in areas of high snow cover than in areas that had minimum snow cover or had been artificially cleared. Values (on a volumetric basis) were much higher than those of rich coastal blooms in temperate areas. However, chlorophyll *a* concentrations expressed on an areal basis were thought to be more representative since sea-ice algae are concentrated in a thin layer at the bottom of the ice. Values ranged from 3.0 mg/m² to 23.0 mg/m². The presence of high chlorophyll values at very low light intensities is considered to be evidence that sea-ice algae are extremely shade adapted. This was thought to be due to the high proportion of chlorophyll *c* found in ice algae; chlorophyll *c* is six times more efficient than chlorophyll *a* in absorbing blue light.

The ice-diatom bloom is separated in time and space from the algal bloom that occurs later in the water column. The sea-ice algal community in Jones Sound probably produces high concentrations of chlorophyll for about seven weeks (late April to mid-June).

It is very likely that within our study area the ice flora contributes greatly to the total primary productivity. However, the actual amount contributed and the significance to higher trophic levels is still unknown.

- Apollonio, A. 1976a. Primary production in coastal waters of the Arctic Ocean. Unpubl. Manuscript. Bigelow Laboratory Contrib. No. 76008. 46 pp.

This report is based on data collected considerably north of our study area in Dumbell Bay near Alert, Ellesmere Island. The author's abstract is included here because of the scarcity of studies of Arctic primary production (and particularly of such studies utilizing the C¹⁴ method).

'Photosynthesis, chlorophyll, inorganic nutrients, and related factors were measured throughout a productive season

in a small coastal inlet of the Arctic Ocean. Significant production was confined to 5 m [and occurred] for a very limited time period because of both light and nutrient limitations. Maximum chlorophyll was 8.2 mg Chl a/m^3 and maximum 'gross' and 'net' photosynthesis rates were 830 and 550 mg C/m²/day. Annual 'gross' and 'net' photosynthesis is estimated at about 12 and 9 g C/m² respectively. The effect of light stimulation on assimilation numbers is described, sources of coastal zone nutrient enrichment are considered, and discrepancies between 'gross' and 'net' photosynthesis are discussed with reference to the growth characteristics of the phytoplankton population.'

- Apollonio, S. 1976b. Primary production in the Canadian Arctic Archipelago, 1961-1963. Unpubl. Manuscript. Bigelow Laboratory for Ocean Sciences. Contrib. No. 76016. 46 pp.

Primary production experiments were conducted for three seasons (1961-1963) in Jones Sound. Observations from Allen Bay in 1956 (Apollonio 1956), Dumbell Bay (near Alert) and the Arctic Ocean in 1959 (Apollonio 1959, 1976a) are included in the discussion.

Light penetration was measured in Jones Sound by submarine photometer. Samples were taken at standard depths for nutrients (nitrate, phosphate, silicate), chlorophyll and oxygen. These data were supplemented by temperature and salinity measurements. Twenty-four hour primary production experiments were performed *in situ* by the oxygen and C¹⁴ methods. These methods were assumed to approximate 'gross' and 'net' photosynthesis respectively.

Results (Jones Sound)

Nutrients

Nitrate concentrations in the upper 25 m were highest in June 1962 (10-11 μg at/1) and June 1963 (5-6 μg at/1). Nitrate was exhausted in the euphotic zone by mid-July.

Near surface phosphate minima ranged from 0.26 $\mu\text{g at/l}$ to 0.6 $\mu\text{g at/l}$ for all three years in mid- or late July.

Silicate concentrations ranged from 25 to 30 $\mu\text{g at/l}$ throughout the water column in the spring. Minimum values were reached in mid- or late July and ranged from 2 $\mu\text{g at/l}$ to 5.2 $\mu\text{g at/l}$ in the upper 10 m.

Chlorophyll Maxima

<u>Late June (2 m under ice)</u>		<u>Early July (5 m under ice)</u>
under melting snow cover	in leads	snow cover completely melted
0.8 mg/m^3	3.4 mg/m^3	*10.3 - 11.8 mg/m^3

*These maxima were never approached in open water after the ice broke up.

Summary of Major Findings (taken from the text)

1. 'Phytoplankton productivity and related environmental factors were measured for six summers in four different locations in the Canadian Arctic and in the Arctic Ocean. The most complete work was done in Jones Sound, 1961-1963. Observations included gross and net photosynthesis, chlorophyll, oxygen, nitrate, phosphate, and silicate concentrations, and light penetration.
2. 'Maximum phytoplankton development, as shown by chlorophyll concentrations, occurred each year in Jones Sound in July while the sea was covered with intact but melting ice. Chlorophyll attained concentrations of 10 or 11 mg/m^3 , and the greatest growth occurred at about 5 m. The euphotic zone was less than 12-15 m deep.
3. 'The maximum chlorophyll concentration remained at 5 m only for a few days and then sank rapidly below the euphotic zone.

This rapid sinking was apparently promoted by nutrient deficiency and marked vertical stability of the water.

4. 'Nitrates were exhausted from the waters at the height of the plankton growth and remained so for the rest of the summer. Considerable photosynthesis was measured after nitrate was completely exhausted.
5. 'Phosphate and silicate concentrations showed similar trends. Both were markedly reduced during the phytoplankton development. Phosphate at no time reached limiting concentrations, but silicates were more seriously depleted and approached limiting concentrations.
6. 'Gross and net photosynthesis rates paralleled the trends in depth and time of chlorophyll concentrations. Maximum gross photosynthesis rates in Jones Sound reached 300 mg C/m³/24 hr.
7. 'At the higher rates of photosynthesis, a considerable discrepancy was found between gross and net values, as has been observed in other regions. This discrepancy is assumed to be a real attribute of photosynthesis at high rates. At lower rates gross and net productivity measurements were similar.
8. 'Total annual production in Jones Sound in 1961 and 1962 was about 35 g C/m² and about 20 g C/m² in 1963.
9. 'Total annual primary production apparently was determined by the initial spring concentrations of nitrate which showed substantial variations from year to year. These variations were perhaps a result of different sources of water in Jones Sound each year.

10. 'Photosynthesis generally occurred at rather low light intensities; maximum photosynthesis, maximum chlorophyll development, and highest assimilation numbers were in the range 100-150 foot candles. The compensation intensity was about 10 foot candles.
11. 'The maximum assimilation numbers are similar to those reported under similar temperature conditions in temperate latitudes. The assimilation numbers and the ratios of net to gross photosynthesis showed a marked drop when the cells are presumed to be deficient in nitrate.
12. 'A distinct "halocline" phytoplankton population has been tentatively identified in three arctic environments. It apparently is different from the main phytoplankton population in species composition, depth range and time, and has quite constant photosynthetic rates and chlorophyll concentrations.
13. 'The arctic phytoplankton population exhibits the characteristics of a "shade" population, but its photosynthetic and physiological responses to the environment suggest that it is stressed by rather than adapted to the cold, dim, nitrate-depleted arctic waters.'

● Petersen, G.H. 1964. The hydrography, primary production, bathymetry, and "tagsâq" of Disko Bugt, West Greenland. Medd. Grønland 159(10): 1-45.

This paper is outside the scope of this review but does have some relevance to Baffin Bay, particularly considering the paucity of primary production studies. The following table is of interest for comparison purposes. Production estimates are based on C^{14} experiments.

Annual Primary Production in Various Danish and South Greenland Localities

Denmark

g C/m²/year

Great Belt (Halskov Rev)	60
Kattegat (Anholt Nord)	61
Sound (near Elsinore)	39
Limfjord (Venø Bugt)	105
Isefjord (Inner Broad)	1175

South Greenland

Outside Narssaq	29
Mouth of Godthaab Fjord	98
Inner part of Godthaab Fjord	
North Greenland	95
Godhavn (Disko Bugt)	36

- Welch, H.E. and J. Kalff. 1975. Marine metabolism at Resolute Bay, N.W.T. Paper presented at the Circumpolar Conference on Northern Ecology. Sept. 15-18, 1975, Ottawa. 8 pp.

This paper is of great interest to the present review as it gives the only measurements to date of marine photosynthesis and respiration in the study area. Epontic (under ice), planktonic and benthic metabolic rates were measured in Resolute Bay or immediately outside the bay (water depth of 15 m).

The primary production (phytoplankton) for an 'average' year (between the extremes of 1971 and 1972) was estimated at 32 g C/m²/year. Planktonic chlorophyll values reached a peak of 100 mg/m² just after break-up in August and declined rapidly at freeze-up to below 0.1 mg/m² during the winter. Chlorophyll concentrations in the water ranged from 0.001 - 0.1 mg/m³ during winter to 15 mg/m³ in August.

The epontic photosynthesis was 'relatively high' but consistent measurements were not possible due to equipment difficulties. Fifteen measurements taken just offshore from the bay on 8 and 13 May 1973 of epontic algal biomass yielded 10.2 - 22.0 (mean = 15.2) mg chl *a*/m².

Benthic respiration was approximated at 126 g O₂/m²/year in Resolute Bay (see paper for details). Benthic gross photosynthesis in Resolute Bay was estimated at 42 g O₂/m²/year (based mostly on measurements in depths from 7 to 11 m) and was strongly depth dependent.

The authors estimated that in Resolute Bay 33% of the total photosynthesis is benthic and 67% is planktonic. The authors maintained that 'epontic photosynthesis in Resolute Bay itself is probably negligible most years because of high snow cover, but offshore there is less snow and the resultant higher epontic algal biomass contributes more significantly to total photosynthesis'. However, Apollonio (1965) mentions a marked decline in chlorophyll in Jones Sound with increased light and some of his highest values were recorded from samples collected under 20-24 cm of snow. Snow cover data for Resolute Bay are not given, but snow was said to be deeper there than offshore. In view of Apollonio's results, it is difficult to attribute the lack of epontic algae to high snow cover.

Offshore, where there is less snow, the epontic algae seemed to be roughly equivalent to shallow water benthos in production; 130 g O₂ (48 g C)/m²/year is given as an approximate figure for total photosynthesis in both nearshore and offshore areas. It appears that Resolute Bay is roughly equal to Frobisher Bay in yearly photosynthesis (from Grainger's 1971 Frobisher Bay data).

The authors postulate (from their own data and from Grainger's 1959 Igoolik data) that an annual metabolic rate of at least 125-150 g O₂/m²/year could be expected in the archipelago. This is three times greater than lakes in the Resolute area and is attributed to the much higher levels of phosphorus

in the marine system (17-18 mg/l of soluble reactive phosphorus (SRP) and 22-26 mg/l of total dissolved phosphorus (TDP) as opposed to <0.7 mg/l SRP and 2 mg/l TDP in Char Lake).

This study, although not based on extensive data, is a valuable initial attempt to place an order of magnitude on the primary production of the area in question. It seems quite likely that this portion of the High Arctic is at least as productive as Frobisher Bay and considerably more productive than the Arctic Ocean. Waters to the east of Resolute that have less snow and ice cover and break up earlier than Resolute Bay, particularly eastern Lancaster Sound and the 'North Water' of Baffin Bay, might have higher levels of annual primary production by phytoplankton. However, other studies in Jones Sound and at Alert, Ellesmere Island, have indicated that the highest levels of primary production in the euphotic zone occur before the ice disappears (S. Apollonio, pers. comm.).

PHYTOPLANKTON

The two references included in this section are the only major publications dealing with the distribution of phytoplankton species in our study area. The most detailed information about species of phytoplankton present and about standing stocks is found in reports reviewed in the 'Interdisciplinary Section' (see Thomson *et al.* 1975; Sekerak *et al.* 1976a,b; Bain *et al.* 1977).

- Grøntved, J. and G. Seidenfaden. 1938. The 'Godthaab' Expedition 1928. The phytoplankton of the waters west of Greenland. Medd. Grønland 82(5):1-380.

Species lists, distributional records, and frequency of occurrence (i.e., rare or common, etc.) of the phytoplankton collected by the 'Godthaab' Expedition are given. Results of previous expeditions (species lists) are also summarized. Nannoplankton (small plankton) was necessarily excluded since nets were the only method of collection, and nets retain only the larger phytoplankton. The taxonomist would find the occasional microphotographs useful, and a few ecological comments are given. Only three surface samples were taken in Lancaster Sound.

- Seidenfaden, G. 1947. Marine phytoplankton. In: N. Polunin (Ed.), Botany of the Canadian Eastern Arctic. Part II. Thallophyta and Bryophyta. Bull. Natl. Mus. Canada. No. 97 : 138-177.

This report presents distributional information for diatoms, peridineans, flagellates and silicoflagellates of the eastern Arctic. Collections west of eastern Lancaster Sound were very sparse. The author made an initial attempt to break the species list into (1) typical arctic, (2) boreal, (3) transitional, (4) temperate and (5) ice or littoral forms. Generally, West Greenland has been found to include more boreal and temperate forms than the eastern Canadian Arctic.

ZOOPLANKTON

The vast majority of the zooplankton references are of a distributional or taxonomic nature. The exceptions are Dunbar (1941a) on the breeding cycle of one species of chaetognath, Dunbar (1946b) on the importance of the amphipod *Parathemisto libellula* as seal food, Grainger (1965) on the development rates of two copepod species, and Mohammed and Grainger's (1974) quantitative zooplankton data. Refer also to the 'Interdisciplinary Studies' section for detailed zooplankton studies in specific areas, particularly Sekerak *et al.* (1976b) for Lancaster Sound, Sekerak *et al.* (1976a) for Creswell and Assistance Bays, and Bain *et al.* (1977) for Wellington Channel.

- Dunbar, M.J. 1941a. The breeding cycle in *Sagitta elegans arctica* Aurivillius. Can. J. Res. 19:258-266.

This paper, though not reviewed here, would be relevant if a detailed impact study was to assess potential effects on the breeding cycles of plankton. Collections extend only as far north as Clyde River.

- Dunbar, M.J. 1941b. Marine macroplankton from the Canadian eastern Arctic. I. Amphipoda and Schizopoda. Can. J. Res. 19:33-46.

Distributional records of twenty-four amphipod species, three euphausiids and two mysids are given. Collection areas included Clyde River, Pond Inlet, Arctic Bay, and Fort Ross, as well as areas further south.

- Dunbar, M.J. 1942. Marine macroplankton from the Canadian eastern Arctic. II. Medusae, Siphonophora, Ctenophora, Pteropoda, and Chaetognatha. Can. J. Res. 20:71-77.

Distributional records of thirteen species of medusae, one siphonophore, two ctenophores, two pteropod molluscs and two chaetognaths are given.

Collections were coastal and included Clyde River, Pond Inlet, Arctic Bay and Fort Ross, as well as areas further south.

- Dunbar, M.J. 1946b. On *Themisto libellula* in Baffin Island coastal waters. J. Fish. Res. Bd. Canada 6:419-434.

Themisto libellula had previously been found to be a very important food item to Ringed Seals (at least during the summer months) (see Dunbar 1941c). As such, it represents a key link in the food chain. *Themisto libellula* (now referred to as *Parathemisto libellula*) was found (in collections ranging as far north as Clyde River, Pond Inlet, and Arctic Bay) to feed primarily on smaller crustacean plankton, and to a lesser extent on 'plant matter'. The gross internal anatomy, local ecology in the summer and the breeding cycles were discussed.

- Dunbar, M.J. 1964. Euphausiids and pelagic amphipods. Distribution in North Atlantic and Arctic waters. Folio 6. Serial Atlas of the Marine Environment. Amer. Geogr. Soc., New York.

This is part of a very useful map series. Unfortunately, data from our study area were very sparse. Two amphipods, *Parathemisto libellula* (Mandt) and *P. abyssorum* (Boeck), are shown in our study area. The euphausiid *Thysanoessa inermis* (Krøyer) is reported to occur off eastern Baffin Island, north of Cumberland Sound.

- Grainger, E.H. 1965. Zooplankton from the Arctic Ocean and adjacent Canadian waters. J. Fish. Res. Bd. Canada 22:543-564.

This classic paper is based on collections considerably outside the geographic boundaries of the present review. It does, however, deserve mention here since the upper waters in our study area are derived from the

Arctic Ocean and could reasonably be assumed to contain zooplankton communities similar in species composition. The deep water of Lancaster Sound (below about 250 m) could be an exception since it is a mixture of Atlantic and Baffin Bay water.

The following is the author's abstract.

'Zooplankton collections from the Arctic Ocean, the Beaufort Sea, and northwestern Canadian coastal waters are described, along with physical characteristics of the waters sampled. About 50 species are included.

'The collections are compared with records from the central Arctic Ocean and other waters adjacent to the present region. The species are shown to fall into three groups. One is characteristic of the surface water of the Arctic Ocean, one of the Atlantic water and to a lesser extent the deep layer of the surface water of the Arctic Ocean, and one of the shallow peripheral seas of the Arctic Ocean.

'The surface water group includes eight species which account for more than 95% of the copepod individuals found in the surface layer, and which appear to be the only copepods which breed in the surface layer of the central Arctic Ocean. The same species are the major constituents of the zooplankton found in the waters of the Canadian arctic, from the Arctic Ocean to Davis Strait. The deeper Atlantic species of the Arctic Ocean, more numerous as species but far less numerous as individuals than those of the surface water, occur only very rarely in the surface layers, show no evidence of breeding there, and appear to be almost entirely absent from Canadian archipelago waters inside the shelf. Clear continuity of the Arctic Ocean surface fauna through the waters of the Canadian arctic is shown, along with the almost total exclusion from archipelago waters of the deeper Atlantic fauna.

The intrusion of Atlantic species into the waters of arctic Canada appears to be almost entirely restricted to the south-east part of the region, especially Hudson Strait and adjacent waters.'

Development rates of two copepods that occur in the Arctic Ocean, *Microcalanus pygmaeus* and *Calanus glacialis*, are discussed.

Jespersen, P. 1923. Dr. Thorild Wulff's plankton collections in the waters west of Greenland. Metazoa. Medd. Grønland 64(4):103-159.

Distributional information is given on the zooplankton collected by the second Thule Expedition from Disco Bay to Smith Sound. Since portions of this material are out of date and since the report deals exclusively with West Greenland, it is deemed to be of very limited relevance.

● Jespersen, P. 1934. The Godthaab Expedition 1928. Copepoda. Medd. Grønland 79(10):1-166.

Distributional information and relative quantities are given. No data are given for Lancaster Sound. Five species were collected from Jones Sound and three from 'just off' Lancaster Sound (*Calanus finmarchicus*, *Acartia longiremis*, *Oithona similis*) in the upper 250 m. Below 250 m thirteen and twelve species were collected from these two areas respectively.

● Kerswill, D.J. 1940. The distribution of pteropods in the waters of eastern Canada and Newfoundland. J. Fish. Res. Bd. Canada 5:23-31.

Clione limacina and *Limacina helicina* were reported from Pond Inlet and Fort Ross, while *C. limacina* was reported from Arctic Bay. Only *Limacina helicina* was reported from Lancaster Sound, although *C. limacina*

is also very common there (Sekerak *et al.* 1976b). The collections in our study area were made by the Eastern Arctic Patrol in 1937-1939.

- Kramp, P.L. 1939. The Godthaab Expedition 1928. Chaetognatha. Medd. Grønland 80(5):1-40.

Distributional information is given for five species. Three species, *Sagitta elegans*, *S. maxima* and *Eukrohnia hamata*, were collected off the eastern entrance to Lancaster Sound. Data on depth of collection and state of maturity are given.

- Kramp, P.L. 1942a. The Godthaab Expedition 1928. Siphonophora. Medd. Grønland 80(8):1-24.

This contains distributional information on seven species. One species, *Dimophyes arctica*, was recorded off Lancaster Sound.

- Kramp, P.L. 1942b. The Godthaab Expedition 1928. Ctenophora. Medd. Grønland 80(9):1-19.

This report contains only distributional information, of five species discussed, two species, *Beroë cucumis* and *Bolinopsis infundibulum*, were collected 'just off' Lancaster Sound.

- Kramp, P.L. 1942c. The Godthaab Expedition 1928. Pelagic Tunicata. Medd. Grønland 80(10):1-8.

This report contains distributional information on three species of larvaceans. One species, *Oikopleura vanhoeffeni*, was collected 'just off' Lancaster Sound.

- Kramp, P.L. 1942d. The Godthaab Expedition 1928. Medusae. Medd. Grønland 81(1):1-168.

This contains distributional information and the occasional drawing that might be useful to the taxonomist.

- Kramp, P.L. 1961. The Godthaab Expedition 1928. Pteropoda. Medd. Grønland 81(4):1-13.

This gives distributional information on the four pteropods collected by the expedition. Of the four species, only *Clione limacina* (Phipps) and *Limacina helicina* (Phipps) were found north of Godthaab. It is interesting to note that these two species were most abundant off the mouth of Lancaster Sound and formed the bulk of the surface plankton there.

- Manton, I., J. Sutherland and B.S.C. Leadbeater. 1975. Four new species of choanoflagellates from Arctic Canada. Proc. R. Soc. Lond. B 189:15-27.

Nannoplankton (very small forms, about 5 to 60 μ) was collected during the summers of 1972 and 1973 from W Greenland, Hudson Bay and Resolute Bay. Nannoplankton as a whole was much more abundant at Resolute. Descriptions, aided by electron microscopy, are given. Three of the four new species were found in Resolute Bay. The ecologic significance of nannoplankton in general is unknown. It is, therefore, impossible to judge the relevance of these species or this paper to impact assessment studies.

- Mohammed, A.A. and E.H. Grainger. 1974. Zooplankton data from the Canadian Arctic Archipelago, 1962. Fisheries and Marine Science Tech. Rept. No. 460. 136 pp.

Zooplankton was surveyed at three major locations: Assistance Bay, Slidre Fjord, and Creswell Bay. Minor locations included Penny Strait,

Nansen Sound, Strand Fjord, M'Clure Strait, Prince of Wales Strait, Wellington Bay and Cambridge Bay.

Assistance Bay and Creswell Bay are of immediate concern in the present review. However, no attempt will be made here to summarize the data in the report since they are presented in tabular form.

The species lists, the numbers of individuals/m³, wet weight/m³ and the vertical distributions of dominant copepods would be of some relevance to an impact study. The limitations of the data include the use of small diameter nets (30 cm), the lack of flowmeter data and the surface nature of the survey (i.e. deepest tow was 50 m).

- Shih, C.-T., A.J.G. Figueira and E.H. Grainger. 1971. A synopsis of Canadian marine zooplankton. Bull. Fish. Res. Bd. Canada No. 176: 189-229.

Canadian Arctic zooplankton (excluding fish eggs and larvae) is listed by species with pertinent references (pre-1970) and location of study. As such, it is an invaluable aid and allows one to rapidly assess the distribution of a particular species.

- Tidmarsh, W.G. 1973. The Copepods (Calanoida, Cyclopoida) of Northern Baffin Bay and southern Nares Strait: Their distribution and aspects of their biology. Baffin Bay - North Water Project Sci. Rept. No. 3, Arctic Institute of North Amer., Washington, D.C. 181 pp.

The main purpose of this work was to study the copepod populations of the 'North Water' and to correlate their distributions with the movement of water masses. Although the 'North Water' is beyond the geographic scope of the present review it does deserve some attention due to its proximity to Lancaster Sound, the direction of the surface currents in that area, and the general lack of detailed studies in Lancaster Sound. It is reasonable to assume that zooplankton populations from the 'North Water' would enter Lancaster Sound along the south coast of Devon Island.

Quantitative and vertical distribution information is somewhat limited in this report because of mechanical difficulties with the closing nets and the total lack of flowmeters. However, 36 species of copepods were identified with *Calanus glacialis* being dominant and ubiquitous. The life cycles of five common species were discussed.

Relevance to a Lancaster Sound impact study, aside from the species lists, is probably limited to the following general observations. The 'North Water' opens earlier than other adjacent areas. This, coupled with some vertical mixing, appears to cause an earlier and more prolonged phytoplankton bloom. While the deeper copepod forms seem unaffected by this, the surface dwelling herbivorous copepods, *C. glacialis* and *C. hyperboreus* complete their life cycles in one year as opposed to the two years noted for other Arctic areas. In addition, the *C. hyperboreus* female reaches a slightly larger size in the 'North Water'. This could have relevance to the northern part of Lancaster Sound particularly since "seemingly higher productivity of the 'North Water' region seems to affect a wider area than does the physical presence of open water".

● Wesenberg-Lund, E. 1936. The Godthaab Expedition 1928. Tomopteridae and Typhloscolecidae. Medd. Grønland 80(3):1-17.

The 'Godthaab' Expedition collected four species of planktonic polychaetes. Only one species, *Tomopteris septentrionalis*, was collected north of 65°N, including 'just off' Lancaster Sound. Distributional and taxonomic notes are included in this paper.

BENTHOS

This section contains references pertaining to benthic algae, intertidal biology, general benthic fauna, specific benthic invertebrate groups (in alphabetical order) and on relevant aspects of marine geology. As with zooplankton, the majority of the benthic work in and adjacent to our study area has dealt with the basic problems of taxonomy and distribution. The 'classic' paper by Thorson (1936), although based on E Greenland studies, is a useful introduction to the general ecology of Arctic benthos. The work by Ellis (1960) is the major study on benthic infauna within our study area. Squires (1968) on the distribution and ecology of decapod crustaceans is perhaps the type of study most relevant to impact studies. Refer also to the 'Interdisciplinary Studies' section.

Algae

- Lee, R.K.S. 1973. General ecology of the Canadian Arctic benthic marine algae. Arctic 26:32-43.

This is a general survey based on collections in 1967 from Hudson Strait, Baffin Bay, Lancaster Sound, Amundsen Gulf and M'Clure Strait to Brock Island. No specific information is given for Lancaster Sound but the following generalities about Arctic benthic algae communities are of some interest.

1. The Canadian Arctic marine flora is composed mainly of Atlantic species. Number of species is generally low.
2. Numbers of species decrease from east to west. This trend was attributed to the more extreme environmental conditions of lower temperature and salinity, longer ice-cover, and possibly lower nutrients in the west rather than to lack of suitable substrate there.

3. The paucity of intertidal flora cannot be attributed to ice scouring since some algal forms are capable of colonization within 15 days. Low temperature and salinity are more likely causes.

● Whelden, R.M. 1947. Algae. *In*: N. Polunin (Ed.), Botany of the Canadian Eastern Arctic. Part II. Thallophyta and Bryophyta. Bull. Natl. Mus. Canada. No. 97:13-137.

This report presents a list of freshwater and marine algal species (excluding marine phytoplankton and freshwater diatoms) collected in a wide variety of habitats and locations in the Canadian Eastern Arctic. Collections were made by N. Polunin of the Canadian Eastern Arctic Expedition of 1936 and were mainly from freshwater. Marine collection locations within our study area included northern Baffin Island and southern Devon Island, particularly Dundas Harbour.

● Wilce, R.T. 1967. Heterotrophy in Arctic sublittoral seaweeds: An hypothesis. *Botanica Marina* 10:185-197.

Wilce puts forward the hypothesis that Arctic sublittoral flora has adapted to the low light environment by supplementing photosynthetic activity with a heterotrophic mode of nutrition. Arctic sublittoral flora in general is characterized by (1) affinity with Atlantic species, (2) low numbers of species, (3) small size, (4) less dense growth, and (5) greater development at lower depths than boreal vegetation.

Intertidal Biology

- Ellis, D.V. and R.T. Wilce. 1961. Arctic and subarctic examples of intertidal zonation. Arctic 14:224-235.

This paper is based mainly on observations by Ellis in 1953 of Frobisher Bay and Cumberland Sound and in 1954, 1955 and 1957 of the shores of Coppermine, Bathurst Inlet, Cambridge Bay, Spence Bay, Arctic Bay, Moffet Inlet, Pond Inlet and Frustration Bay, Rowley Island. Although algal collections were apparently scanty and the discussion is confined mainly to southeastern Baffin Island, the following generalizations are made about the more northern shores of the Arctic Archipelago.

1. 'Populations on rocky shores in Arctic and subarctic regions of eastern North America exist only where thickness of shore ice is less than the tidal amplitude.
2. 'Populations on arctic rocky shores are rare and limited to low levels.
3. 'Populations on arctic sedimentary shores are very rare and much reduced.'

There is a very real danger in applying these generalizations to an oil impact assessment because a 'logical' conclusion could be drawn that oil would have minimum effect on a very sparse environment. It should be emphasized that the authors of this paper are generally referring to non-motile members of the community. Observations at Resolute Bay, Creswell Bay and Cunningham Inlet indicate that motile animals, particularly amphipods, are very often concentrated at the tidal interface (pers. obs.; also D. Thomson of LGL Ltd. pers. comm.). These concentrations (quantified for Creswell Bay in Alliston *et al.* 1976) are utilized as major food items by shorebirds and seabirds (M. Bradstreet of LGL Ltd. pers. comm.) and fish, particularly Arctic char (A. Sekerak of LGL Ltd. pers. comm.).

General Benthic Fauna

- Ellis, D.V. 1957a. Marine infaunal benthos in Arctic North America. Ph.D. Thesis, McGill University. 98 pp.

(See Ellis 1960).

- Ellis, D.V. 1960. Marine infaunal benthos in Arctic North America. Arctic Institute of North Amer., Tech. Paper No. 5. 53 pp.

This study is of particular relevance because it is one of very few quantitative benthic works done in our study area. 'North Baffin Island' is in effect Arctic Bay, Adams Sound and Pond Inlet, since that was where the collections were taken.

The paper is best summarized for our purposes by pertinent sections from the author's summary.

'Quantitative surveys of marine infaunal benthos were made in north Baffin Island during 1954 and 1955, in Greenland during 1956, and in Foxe Basin during 1957.

'Species found in each area are tabulated, and mean numbers and weights per sq. m. calculated. Lamellibranchs represented between 60 per cent and 80 per cent of the crop in north Baffin Island and near Godthaab, but were partially replaced by polychaetes in shallow water in Disko Bugt. The ratio between the amount of dry organic matter and fresh weight of animals varied with the taxonomic groups. The weight of dry organic matter in shallow water (to 50 metres depth) was generally 15 gm. per sq. m. or more, and in deeper water generally 10 gm. per sq. m. or less.

'There are many possible sources of error in making quantitative surveys of the benthos, e.g., variable penetration by the sampler, and these are difficult to eradicate with present methods of collecting specimens. The collecting errors cause the recorded numbers and weights of animals per haul to vary; but some of the numerical variation also arises from natural phenomena, e.g., grouping of animals. The variation in the quantitative data is so great that they cannot be used as reliable estimates of the numbers and weights of animals per unit area of bottom. But the results of these surveys do show which species occur in a large percentage of the hauls and hence are widely spread in the investigated regions, which species are numerous in the hauls and hence are scattered densely over the bottom, and which species occur as heavy individuals or groups and hence contribute much to the total weight of animals per unit area. The surveys reveal the marine level-bottom communities present and provide rough estimates of the standing crops of animals within the communities.

'*Macoma* communities occurred in north Baffin Island on mud, sandy-mud, and sand bottom 5-20 metres depth.

'The *Macoma* communities in north Baffin Island appeared to change to foraminifera communities between 20 and 50 metres depth (the maximum sampled). In Laksebugt, Disko Bugt, a similar change occurred between 30 and 50 metres. The foraminifera community there extended to at least 170 metres.

'*Macoma* communities appear to be very widely spread in shallow water to about 50 metres depth in arctic North America, being replaced by others mainly on localized, unusual substrates. An infaunal change with depth also appears to be widespread, with shallow-water communities being replaced by others below 50 metres.

'Periodic fluctuations in the composition of arctic marine level-bottom communities appear to be small.

'The effects of substrate on arctic shallow-water infauna can usually be described within the known limits of variability of the *Macoma* communities. Occasionally substrate affects the composition of the fauna so greatly in shallow water, that the resulting species association justifies being regarded as a distinct community, e.g., the *Portlandia arctica* and *Gomphina fluctuosa* communities on mud and sand respectively.

'Standing crop estimates for *Macoma* communities near the open sea generally indicate more than 1,000 animals (retained by 1- to 2-mm. sieves) per sq. m. weighing more than 2 gm. per sq. m. Special conditions may reduce the crops, e.g., at the heads of fiords, in very shallow water 0-5 metres depth, and on stagnant bottom. In north Baffin Island sandy-mud appeared to support greater crops than either mud or sand, possibly due to the proximity of this type of sediment to river mouths, which would develop a locally high organic content in the sediments.

'The oceanographic conditions influence the infauna through three dimensions, and its effects are considered under three categories--depth, latitude, and combined depth and latitude effects.

'Oceanographic effects with depth are as follows: The "fjord-water" layer supports very few animals; it may be absent or extend to about 5 metres depth. *Macoma* and other shallow-water communities, often with large crops, occur to about 50 metres depth, coinciding approximately with the extent of insolation effects in polar water. Deeper foraminifera and *Astarte crenata* communities, with small crops, occur below the shallow-water communities. In two regions where surface

insolation is negligible, only *Chiridothea sabini* communities have been found in shallow water. The deep-water communities have smaller crops (by weight) than the shallow-water communities, but swarms of benthic foraminifera in deep water may keep the density of animals as high as in shallow water.

'The size of the infaunal crop seems unaffected by the change from Arctic to Subarctic because the known size of standing crops is as large in the Arctic as in warmer regions.

'The long life of the dominating lamellibranchs, the small number of species reproducing by pelagic larvae, and the low weight of predators all indicate a lower rate of infaunal production in the Arctic than in warmer marine regions.'

● Thorson, G. 1936. The larval development, growth, and metabolism of Arctic marine bottom invertebrates. Medd. Grønland 100(6):1-155.

A review of this northeast Greenland study is outside our frame of reference. However, the following general conclusions are applicable to predicting impact on arctic benthos.

1. About 95% of arctic benthic invertebrates reproduce without pelagic larvae. However, the 5% that do have pelagic larvae tend to dominate quantitatively. Pelagic larvae are presumably timed to occur at the season of maximum food availability.
2. Arctic benthic invertebrates, particularly molluscs (which often dominate arctic benthic communities), are characterized by slow growth, late sexual maturity and a long life.

The above conclusions suggest that an Arctic benthic community would take a much longer time to recover from environmental damage than a temperate community. This could have serious effects on higher vertebrates that depend on the benthic fauna for food.

Amphipods

- Laubitz, D.R. 1972. The Caprellidae (Crustacea, Amphipoda) of Atlantic and Arctic Canada. Natl. Mus. of Canada, Publ. in Biol. Oceanogr. No. 4. 82 pp.

This is a taxonomic and distributional summary of the twenty-one species of caprellid amphipods known to occur in the Canadian Arctic and Atlantic. It is based on numerous museum specimens and previous literature. Seventeen species are described in detail and an identification key is included.

There is very little detail as to specific locations of collections. However, two species have been collected in Lancaster Sound (*Aeginina longicornis* and *Metacaprella horrida*) and a third, *Caprella septentionalis*, was collected north and south of our study area. The author indicates that two other species occur in the North American Arctic, but collections have not been extensive enough to determine whether these occur in our study area.

- Steele, D.H. and P. Brunel. 1968. Amphipoda of the Atlantic and Arctic coasts of North America : *Anonyx* (Lysianassidae). J. Fish. Res. Bd. Canada 25:943-1060.

This report provides extensive taxonomic and distributional information based on over 800 collections from numerous museums. Eight species are described in great detail. Two of these eight have been found in our study area (*Anonyx nugax*, *A. sarsi*).

- Steele, D.H. and V.J. Steele. 1974. The biology of *Gammarus* (Crustacea, Amphipoda) in the northwestern Atlantic. VIII. Geographic distribution of the northern species. Can. J. Zool. 52:1115-1120.

Two of the 10 species discussed occur in our study area. Distributional information is derived from the 'Calanus' collections, collections by the author, and literature records. They are important organisms in the diets of fish and birds (e.g., Sekerak *et al.* 1976a; Bradstreet 1976). Some aspects of their biology are summarized below.

Gammarus wilkitzki--large circumpolar species; often described as planktonic but seems to be more commonly associated with ice; when the ice melts it may be found in the intertidal zone, plankton, or benthos.

Gammarus setosus--a circumpolar, intertidal species; the most common gammarid amphipod north of Labrador.

- Stephensen, K. 1933. The Godthaab Expedition 1928. Amphipoda. Medd. Grønland 79(7):1-88.

The 'Godthaab' Expedition collected 96 species of amphipods, bringing the total number of species of amphipods known to occur in the Baffin Bay area to 249. This paper contains distributional data and some drawings to aid in identification.

Bryozoans

- Powell, N.A. 1968. Bryozoa (Polyzoa) of Arctic Canada. J. Fish. Res. Bd. Canada 25:2269-2320.

This report summarizes systematic, bathymetric and distributional information for 93 species of Arctic bryozoans, many of which would

undoubtedly be found in our study area. Photomicrographs are included for 47 species. However, none of the bryozoan collections, with the exception of 6 from Creswell Bay, were from Lancaster Sound and vicinity.

Decapod Crustacea

- Heegaard, P.E. 1941. Decapod crustaceans. The zoology of east Greenland. Medd. Grønland 121(6):1-72.

Refer to Squires (1968) for distributional information within our study area.

- Squires, H.J. 1968. Decapod Crustacea from the Queen Elizabeth and nearby islands in 1962. J. Fish. Res. Bd. Canada 25:347-362.

Squires has examined decapod Crustacea in shallow water (<70 m) benthic samples from Cornwallis Island, Penny Strait, Slidre Fiord, Nansen Sound, Axel Heiberg Island, Prince of Wales Strait, M'Clure Strait, Creswell Bay, Cambridge Bay and Victoria Island. The most intensive sampling was in the Resolute area of Cornwallis Island (51 samples) and Creswell Bay, Somerset Island (70 samples). These two areas, and perhaps Penny Strait (5 samples), are of interest to the present review.

Seven of the ten species of decapod shrimp that were identified were collected from the three areas of primary interest (near Resolute, Penny Strait and Creswell Bay). The following is a brief summary of these seven species.

1. *Eualus gaimardi* (H. Milne-Edwards)--collected from all three areas (in depths from 5 to 62 m); previously recorded from Jones Sound and Coburg Island by Van Winkle and Schmitt (1936) and from Belcher and Wellington Channels by Heegaard (1941); a slow

growth rate and late maturity seem likely for this species; food items included phyto­benthos, detritus and occasional foraminiferans.

2. *Spirontacaris phippsi* (Krøyer)--collected from all three areas (in depths from 5 to 62 m); previously recorded from Jones Sound by Heegaard (1941); food items included phyto­benthos, detritus, occasional foraminiferans and crustaceans.
3. *Lebbeus groenlandicus* (Fabricus)--collected at Resolute in 10-30 m of water; lesser numbers taken from Creswell Bay at the same depths; previously recorded from Coburg Island (Van Winkle and Schmitt 1936) and Jones Sound (Heegaard 1941); food items included phyto­benthos, detritus, occasional foraminiferans, crustaceans and small bivalves, seaweed and infrequent small gastropods.
4. *Lebbeus polaris* (Sabine)--the most abundant species; collected from all three areas of interest in depths from 0 to 52 m; previously recorded from Coburg Island and Jones Sound (Stephensen 1935; Van Winkle and Schmitt 1936) and from Hazen Strait, Barrow Strait and southeast of Somerset Island (Heegaard 1941); food items included phyto­benthos, detritus, occasional foraminiferans and crustaceans, and infrequent small gastropods and polychaetes.
5. *Sabinea septemcarinata* (Sabine)--most abundant near Resolute but also collected in Creswell Bay in depths from 0 to 70 m in both areas; previously recorded from Jones Sound and Wellington Channel (Heegaard 1941); food items included phyto­benthos, detritus and crustaceans.

6. *Argis dentata* (Rathburn)--one collected near Resolute in shallow water; previously recorded near Coburg Island by Heegaard (1941).
7. *Sclerocrangon boreas* (Phipps)--collected in Creswell Bay and near Resolute at depths less than 30 m with largest numbers near Resolute; previously recorded from Coburg Island and Jones Sound (Van Winkle and Schmitt 1936) and from Wellington Channel, Barrow Strait and Lancaster Sound (Heegaard 1941); food items included phytobenthos, occasional foraminiferans and crustaceans, infrequent small gastropods and polychaetes and sponge spicules.

No attempt could be made in this study to adequately quantify the abundance of these species since a wide variety of collection methods was used (i.e., small otter trawls, dredges, grabs, bottom sleds and gill net). This paper is, however, a valuable species record with notes on distribution in the Canadian Arctic and Greenland, size, maturity, stomach contents and degree of adaptation to a low temperature environment. It is of relevance to future environmental studies in that it indicates what species are present and it is an initial attempt at detailing the bottom feeding habits of these species. This type of study is of particular importance if these decapod shrimp are found to be major food items of seabirds or marine mammals.

● Stephensen, K. 1935. The Godthaab Expedition 1928. Crustacea Decapoda. Medd. Grønland 80(1):1-94.

The species list for Baffin Bay was brought to a total of 41 species. Distributional information is given and the taxonomy of the larval forms is described.

- Van Winkle, M.E. and W.L. Schmitt. 1936. Notes on the Crustacea, chiefly Natantia, collected by Captain Robert A Bartlett in Arctic Seas. J. Wash. Acad. Sci. 26:324-331.

This report gives distributional information only and is summarized for the study area by Squires (1968).

Echinoderms

- Grainger, E.H. 1964. North American sea stars (Echinodermata : Asteroidea) from North Alaska to the Strait of Belle Isle. Folio 5. Serial Atlas of the Marine Environment. Amer. Geogr. Soc., New York.

This very useful map series considers twenty-six species, probably only three of which are circumpolar; twelve are Atlantic, seven are Atlantic and Pacific and four are Pacific forms. The report includes information about horizontal and vertical distribution and substrate. Information from western Baffin Bay and Lancaster Sound was very scanty. Some data were included for the eastern entrance to Lancaster Sound, Assistance Bay, Jones Sound, Creswell Bay and northeastern Somerset Island.

- Grainger, E.H. 1966. Sea stars (Echinodermata : Asteroidea) of Arctic North America. Bull. Fish. Res. Bd. Canada 152:1-70.

This report contains taxonomic (includes a species key) and distributional information for 29 species of sea stars. Notes are given on depth, substrate and exact location of collection. Collection stations in our study area included east Somerset Island, south Cornwallis Island and west Devon Island. Based on the distribution maps at least 13 species could occur in the study area.

- Mortensen, Th. 1932. The Godthaab Expedition 1928. Echinoderms. Medd. Grønland 79(2):1-62.

Ninety-nine species are listed here as occurring in the Baffin Bay area. Detailed distributional information is presented for 58 species. Eleven species were collected 'just off' the eastern entrance to Lancaster Sound at a depth of 680 m.

Hydroids

- Calder, D.R. 1970. Thecate hydroids from the shelf waters of northern Canada. J. Fish. Res. Bd. Canada 27:1501-1547.

Fifty-four species of thecate hydroids were identified from the shelf waters of northern Canada between northeastern Newfoundland and the Alaska-Yukon border. The identifications are based mainly on material from the 'Calanus' and 'Salvelinus' expeditions initiated in 1947. The total number of species known to occur in this area was brought to 71. Only five collections from our study area contained thecate hydroids--three collections in Barrow Strait and two in Creswell Bay. Brief notes on substrate are included.

The relevance of this report to impact assessment is limited to taxonomic and distributional data.

- Calder, D.R. 1972. Some athecate hydroids from the shelf waters of northern Canada. J. Fish. Res. Bd. Canada 29:217-228.

This paper contains taxonomic, distributional and some limited substrate information on sixteen species of athecate hydroids collected by 'Calanus' and 'Salvelinus' expeditions from 1947 to 1972 between the Alaska-Yukon border and the Strait of Belle Isle. Only one collection site in our study area, Barrow Strait, yielded athecate hydroids. The total number of species reported from Canada's north coast was increased to 21.

Molluscs

- Clarke, A.H. 1974. Molluscs from Baffin Bay and the northern North Atlantic Ocean. Natl. Mus. Canada, Publ. in Biol. Oceanography No. 7. 23 pp.

This paper discusses 174 species of molluscs primarily taken from archibenthal and abyssal depths by forty-eight dredge hauls in Baffin Bay and the North Atlantic between Newfoundland and Iceland in 1961, 1970 and 1971. From the minimum depth ranges and locations of collection given by the author as many as 50 of these 174 species may occur in deep waters of Lancaster Sound (mainly the eastern entrance) and Baffin Bay.

The study is of interest in that it gives some indication of the deep water mollusc species likely to be encountered in Lancaster Sound and adjacent waters. However, it is probably of limited relevance to any impact assessment of oil drilling due to the lack of quantitative information. It is also unlikely that an impact assessment or prediction study, unless it was long-term in nature, would consider deep water benthos.

- Lemche, H. 1941. The Godthaab Expedition 1928. Gastropoda Opisthobranchiata (excl. Pteropoda). Medd. Grønland 80(7):1-63.

Thirty species are listed with distributional notes; eight were actually collected by the 'Godthaab' Expedition. Apparently none were collected at the station 'just off' Lancaster Sound. However, three species, *Cylichna alba*, *C. solitaria*, and *Philine firmarchica*, were reported from northeastern Baffin Island.

- Lubinsky, I. 1972. Marine bivalve molluscs of the Canadian Arctic. Ph.D. Thesis, McGill University. 735 pp.

This most impressive and voluminous zoogeographical study of shallow-water bivalve molluscs is a synthesis of all previous scattered literature

and museum specimens dating back to about 1819. More recent collections were obtained from the Fisheries Research Board of Canada and the National Museum, and by the author. The thesis is basically a catalogue of all known shallow water bivalves from the Canadian Arctic and is the only available work of its kind. Although relatively few collections were actually taken from our study area, the other collections are probably extensive enough geographically to indicate which species occur in our area of interest. The boundaries for the study were Alert, Ellesmere Island to the north; Cape Bathurst to the southwest; and the Strait of Belle Isle to the southeast.

The catalogue lists 62 species, five new to the area and two new to science. A total of 47 species were collected from our actual study area. The report includes descriptions, notes on substrate, distribution maps, photographs of previously unillustrated forms, and rough estimates of abundance when possible (i.e. 'abundant', 'common', or 'rare').

The relevance of this study is in its designating 'the probable presence' of certain species. The following ecological comments, which are essentially a summary of Thorson (1936, 1946, 1950, 1952, 1956, 1957), Ockelmann (1958) and Mileikowsky (1961), are also of general interest.

1. Arctic bivalves are characterized by either the total lack of planktonic larvae or a shortened planktonic life stage. The result of this is that most species disperse very slowly.
2. Arctic bivalves reproduce only in the summer, in contrast to much longer reproductive periods farther south.
3. There is a much higher rate of hermaphroditism among Arctic molluscs.

4. Of the bivalve species in the Canadian Arctic, 86% are sedimentation feeders.
5. The number of species of shallow water molluscs is much smaller in the Arctic than at lower latitudes. Lubinsky attributes this low diversity more to the youth of the ecosystem than to the environmental stresses of temperature and salinity extremes or variations.

● Macpherson, E. 1971. The marine molluscs of Arctic Canada. Natl. Mus. Canada, Publ. in Biol. Oceanography No. 3. 149 pp.

This is the first general reference on prosobranch gastropods, chitons and scaphopods of the Canadian Arctic. It is based on 20 years of collections throughout the Canadian Arctic and as such it encompasses our study area. Available information about the distribution and taxonomy of the 108 species known to occur in the Canadian Arctic is summarized, and a bibliography is provided. At least 57 species are known to occur within our study area.

The following ecological comments are of some relevance in predicting environmental damage to Arctic benthic communities.

1. Gastropods form a very small percentage (1-7%) of the biomass of Arctic benthic fauna. Gastropods form a much higher percentage of the epifauna on marine algae.
2. Arctic gastropods, chitons and scaphopods have a high tolerance of environmental variation as evidenced by their extensive ranges.
3. About 60% of the chitons, scaphopods and gastropods are carnivorous. They themselves form parts of the diets of starfish, fish, birds, bearded seals, walruses and other molluscs.

- Thorson, G. 1951. The Godthaab Expedition 1928. Scaphopoda, Placophora, Solengastres, Gastropoda Prosobranchiata, Lamellibranchiata. Medd. Grønland 81(2):1-117.

Distributional and taxonomic information is presented for these molluscan groups. Fifty-five species were noted in collections from 'just off' Lancaster Sound and northward.

Polychaetes

- Curtis, M.A. 1972. Depth distribution of benthic polychaetes in two fiords on Ellesmere Island, N.W.T. J. Fish. Res. Bd. Canada 29:1319-1327.

This study was conducted considerably north of our study area. However, it is of some relevance because of the paucity of quantitative benthic work in our area and the fairly ubiquitous nature of polychaetes; hence the author's abstract is included here.

'The benthic fauna of Hare and Tanquary fiords was collected in replicate grab samples taken at standardized depths from 6 to 100 m. From this collection, 68 polychaete species were identified. Two of these, *Hartmania moorei* Pettibone and *Zeppelinina monostyla* (Zeppelin), have not previously been reported in the Arctic. Population densities of common species demonstrate a marked relation to depth and the distributions of single species were similar in each fiord. Distributions at less than 10 m in Tanquary Fiord appear to be greatly modified by the presence of fiord water, a brackish surface layer formed during the summer ice melt. Among the polychaetes, depth ranges and depths of greatest abundance usually differed and so the species appeared to be scattered along the depth gradient rather than grouped in distinct assemblages.'

- Wesenberg-Lund, E. 1950. The Polychaeta of West Greenland. Medd. Grønland 151(2):1-171.

Distributional information is given with some comments on preferred depths and substrates. It includes data from the Godthaab collections.

Pycnogonids

- Hedgpeth, J.W. 1963. Pycnogonida of the North American Arctic. J. Fish. Res. Bd. Canada 20:1315-1348.

This report contains distributional information, some taxonomic aids, and a few ecological notes for 22 species of pycnogonids (sea spiders) found between Point Barrow and the Baffin Bay-Davis Strait region. Collections from Creswell Bay and S Cornwallis Island indicate that there are at least six species of this interesting (but little studied) group in the study area.

Marine Geology

A review of marine geological papers is outside the scope of the present bibliography. However, the five recent papers mentioned below are concerned specifically with the area in question and have relevance to benthic ecology.

- Blake, W. and C.F.M. Lewis. 1974. Marine surficial geology: Observations in the high Arctic, 1974. Geol. Surv. Can., Paper 75-1, Part A: 383-387.

This report is based on Shipek grab samples and core samples and is supplemented by bottom photographs. The most common type of bottom encountered in Barrow Strait is characterized by 'a lag gravel surface in which many of the angular rock fragments are more than 10 cm in diameter'.

The subsurface material consisted of highly calcareous, firm, sandy, silty grey mud with admixed pebbles.

- Bornhold, B.D. 1976. Marine surficial geology: Central and eastern Arctic. Geol. Surv. Can., Paper 76-1, Part A: 29-31.

This report is based on 91 Shipek grab samples from eastern Viscount Melville Sound and 38 grab samples and one gravity core from Strathcona Sound. Temperature and salinity profiles were also obtained by YSI Salinometer at 33 stations in Strathcona Sound.

The following is the author's description of the sediments in Strathcona Sound with brief comments on fauna.

'Sediments in the upper basin consist of a soft brown clay overlaying intensely mottled, compact grey clay with abundant black streaks throughout. Macroscopic fauna was restricted to a few species of polychaetes.

Sediments in the main basin and at the entrance to the sound are similar to those in the upper basin but are lighter brown in colour and contain a somewhat more diverse fauna. Samples taken on the sills between the basins and in the mouth of the sound contained a significantly higher concentration of sand and pebbles than those from within the basins.'

Temperature and salinity distributions at the surface are discussed but no mention is made of vertical distribution other than 'each station displayed a marked temperature and salinity discontinuity between 15 and 20 m'.

- Henderson, P.J. 1967. Textural study of sediments of Barrow Strait, District of Franklin. Bedford Inst. of Oceanogr. Unpubl. Manuscript Rept. 67-6: 35 pp.

The bottom sediments of West Barrow Strait are described on the basis of 139 bottom samples. The main source of sediment in Barrow Strait appears to be sea-ice.

- Taylor, R.B. 1975. Coastal investigations of northern Somerset Island and Barrow Strait, District of Franklin. Geol. Surv. Can., Paper 75-1, Part A: 501-504.

Beach surveys in 1972-1974 along the north coast of Somerset Island indicated little change between 1972 and 1973 other than minor ice-push. Between 1973 and 1974 the beaches underwent extensive changes due to an early break up in Barrow Strait with the resultant generation of storm waves from the northwest and northeast. The storms pushed ice tens of metres inland and there was considerable wave overwash.

Temperature and salinity data were obtained from Cunningham Inlet, which displayed typical estuarine features. The water column in Cunningham Inlet warmed considerably during the summer with an increase in temperature by at least 7.5°C at the surface and by at least 3.5°C at the seabed (no depth given, however). The reader is referred to Thomson *et al.* (1975) for a more complete description of the physical oceanography of Cunningham Inlet.

- Taylor, R.B. and C.F.M. Lewis. 1975. Nearshore marine geological reconnaissance at Cunningham Inlet, Somerset Island, N.W.T. Geol. Surv. Can., Paper 75-1, Part A: 505-507.

This paper describes the bathymetry of the entrance to Cunningham Inlet. Comments are made on the sediment of the entrance and adjacent Barrow Strait based on 23 Shipek grab samples and five gravity cores. Visual observations and side scan sonar allowed some information to be gathered on ice scouring.

Numerous kelp strands were observed in the estuarine channel and there was some evidence of removal by ice. Sediment in the channel consisted of a 'very putrid-smelling, dark grey mud of fine sand and silt'. The authors appear to be referring to anoxic sediments. These comments provide a useful supplement to the extensive benthic sampling of Thomson *et al.* (1975) in Cunningham Inlet proper.

NEKTON (excluding mammals)

The 'Nekton' section includes squid and fish. Neither group has been intensively studied within the study area. Of the references listed below, two are of special relevance. C.W.S. (1972) is useful in determining important areas for anadromous Arctic char and Bohn and McElroy (1976) establish some preliminary background levels of trace metals in Arctic cod from Strathcona Sound. Refer also to the 'Interdisciplinary Studies' section, particularly Bain *et al.* (1977), Sekerak *et al.* (1976a) and B.C. Research (1975).

Squid

- Mercer, M.C. 1968. A synopsis of the recent cephalopods of Canada. Proc. of Symposium on Mollusca. Part I. 265-276.

It is evident that Canadian Arctic cephalopods have been little studied. Whether this is a result of their scarcity or the lack of scientific effort is open to question.

Mercer lists one species of squid, *Rossia molleri*, as endemic to the Arctic. One species of octopod, *Bathypolypus arcticus*, has been reported from Baffin Bay (location?) and Franklin Bay. A squid that has been reported from the western Arctic, *Gonatus fabricii*, is described as a North Pacific form that is also found in the North Atlantic.

- Muus, B.J. 1962. The Godthaab Expedition 1928. Cephalopoda. Medd. Grønland 81(5):1-23.

Distributional information for seven species likely to be encountered in West Greenland waters is given. Records for the Lancaster Sound vicinity are too incomplete at present to ascertain the status of these species there. However, *Rossia molleri* does not appear to be found south of 65°N and *Gonatus fabricii* does not appear to breed north of Davis Strait, although adults are found much farther north.

- Nesis, K.N. 1965. Distribution and feeding of young squids *Gonatus fabricii* (Licht.) in the Labrador Sea and the Norwegian Sea. *Oceanology* 5:102-108.

Although the data for this paper were collected outside our study area, the following points are of relevance to an environmental impact assessment in Lancaster Sound vicinity.

1. Adults do appear in the High Arctic, though the young apparently do not.
2. The importance of *Gonatus* as food to Narwhals, Belugas, seals, seabirds, Greenland sharks and other fish is emphasized.
3. Identified food items have included copepods, euphausiids, amphipods, pteropods and chaetognaths. Adults seem to select the larger crustaceans.

Fish

- Beck, B. and A.W. Mansfield. 1969. Observations on the Greenland shark, *Somniosus microcephalus*, in northern Baffin Island. *J. Fish. Res. Bd. Canada* 26:143-145.

Eighteen immature Greenland sharks (217-311 cm) were captured incidental to a study on Narwhal. They were presumably drawn to the camp at Koluktoo Bay (SW of Pond Inlet) by offal discarded from whaling operations. Stomach contents of the sharks consisted primarily of offal but they had also been feeding on benthic organisms. One shark's stomach contained two egg cases of the Arctic skate, *Raja hyperborea*, previously unrecorded from that area.

● Bohn, A. and R.O. McElroy. 1976. Trace metals (As, Cd, Cu, Fe, and Zn) in Arctic cod, *Boreogadus saida*, and selected zooplankton from Strathcona Sound, northern Baffin Island. J. Fish. Res. Bd. Canada 33:2836-2840.

The following three points are of particular interest and have some relevance to the present review. The first was the main purpose of the study. The next two, though incidental to the main purpose, are valuable observations on the natural history of Arctic cod.

1. Background levels of metals present at detectable concentrations in the zinc-lead ore of the Strathcona mine were determined for Arctic cod (muscle, liver, and whole fish). Comparisons to other areas would be helpful but are not given. Lead was omitted from the results for some reason not stated. Analysis was also performed on unsorted copepods and to a limited extent on planktonic amphipods (10 individuals).

Comparison of metal levels (Mean $\pm$ SD in ppm dry wt.); numbers in parenthesis are the number of determinations.

Trace Metal	Muscle(7)	Liver(16)	Whole Fish	Copepods(2)	Planktonic Amphipods(1)
As	46 $\pm$ 18	5.6 $\pm$ 1.5	14 $\pm$ 5.4(84)	5.6/7.3	7.9
Cd	<0.5	0.72 $\pm$ 0.37	0.62 $\pm$ 0.22(47)	5.0/2.8	7.0
Cu	4.0 $\pm$ 0.90	3.7 $\pm$ 1.1	4.1 $\pm$ 1.1(84)	3.7/3.4	26
Fe	29 $\pm$ 8.5	39 $\pm$ 9.0	125 $\pm$ 39(84)	78/75	87
Zn	34 $\pm$ 4.5	19 $\pm$ 4.0	90 $\pm$ 19(84)	60/75	43

2. The Arctic cod was the most abundant fish below 100 m and was collected in appreciable numbers by trawl at depths between 120 and 300 m.
3. Stomach contents of fish <10 cm in length were primarily copepods (65%). Larger fish (>10 cm) contained only 30%

copepods. Planktonic amphipods composed 10 and 5%, respectively, of the diets of these two size classes of Arctic cod. The basis of these percentages (i.e. by volume, weight, or numbers) is not stated.

● Canadian Wildlife Service. 1972. Arctic Ecology Map Series. Descriptive Reports. Prepared by Renewable Resources Consulting Services Ltd. 324 pp.

This publication is of limited use in relation to fish because of the lack of quantitative information on anadromous fish. However, it does identify some of the important Arctic char areas. Known critical locations within our study area include

Eclipse Sound

1. important char run near Pond Inlet including Utuk Lake, probably utilized by native population;
2. annual productivity of 10,000 pounds of Arctic char has been suggested for the Robertson River system at the head of Milne Inlet;

Somerset Island

3. Stanwell-Fletcher Lake population;

Cornwallis Island--Wellington Channel

4. char run from Copeland Point;

Prince Regent Inlet

5. char and trout in lake and river system of southern Brentford Bay, NE Boothia Peninsula;

Northeastern Baffin Island

6. Esquimaux River system;
7. Clyde Inlet-Clyde River system--supposedly enough char to support a fishery.

- Dunbar, M.J. 1947. Marine young fish from the Canadian eastern Arctic. Bull. Fish. Res. Bd. Canada 73:1-11.

This is an annotated species list based on plankton collections from northern Labrador, Port Burwell, Lake Harbour, Frobisher Bay, Pangnirtung, Clyde River, Pond Inlet, Arctic Bay and Fort Ross. Of the ten species collected, only one, *Boreogadus saida*, was noted for northern Baffin Island. This was thought to be due, at least in part, to the lateness of the sampling season in that area. Presumably, the other species had left the plankton to commence their benthonic existence.

- Dunbar, M.J. 1970. On the fishery potential of the sea waters of the Canadian north. Arctic 23:150-174.

At present, the only potential commercial fish species in our study area might be Arctic char and the Greenland shark.

- Ellis, D.V. 1962. Observations on the distribution and ecology of some Arctic fish. Arctic 15:179-190.

This is an annotated species list compiled from scattered collecting sites at Coppermine, Bathurst Inlet, Cambridge Bay, Spence Bay, near Arctic Bay and Pond Inlet. Twenty-seven species were recorded. Nine of these were from the area of interest--Arctic char, *Salvelinus alpinus* (L.); Arctic cod, *Boreogadus saida* (Lepechin); Rat-tail, *Coryphaenoides rupestris*

Gunner; Arctic staghorn sculpin, *Gymnocanthus tricuspis* (Reinhard);
Twohorn sculpin, *Icelus bicornis* (Reinhardt); Fourhorn sculpin, *Myoxocephalus*
quadricornis (L.); *Cyclopteropsis jordani* Soldatov; Fish-doctor, *Gymnelis*
viridis (Fabricius); *Lycodes* sp.

- Hildebrand, S.F. 1939. An annotated list of the fishes collected on the several expeditions to Greenland, the Fox Basin region, and the coast of Labrador by Captain R.A. Bartlett, from 1925 to 1935. Medd. Grønland 125(1):1-12.

Nineteen species are listed and their locations of collection given. This would be of limited applicability to the Lancaster Sound vicinity.

- Hildebrand, H. 1948. Marine fish of Arctic Canada. M.Sc. Thesis, McGill University. 123 pp.

This thesis is based on previous literature, the examination of numerous museum specimens, and the author's collections in Ungava Bay. One hundred and twenty-two species were listed for the Canadian Arctic from Alaska to West Greenland. Exact collection locations are not given. Species accounts include distribution, habits and economic importance if known.

The following is the species breakdown by area.

West Greenland	86	species	
Hudson Bay and Strait	32	"	
Ungava Bay	31	"	
Boothia Peninsula	10	"	(based on very few reports)
Mackenzie District	23	"	
High Arctic (Parry Channel and Sverdrup Archipelago, Ellesmere Island and NW Greenland)	19	"	

The 'High Arctic' designation can be considered to encompass our study area. The low number of species recorded partly reflects the relatively low intensity of collection effort. It is obvious, however, that our study area contains few fish species relative to West Greenland and areas further south.

Ungava Bay and Baffin Bay were noted as faunal transition zones.

- Jensen, Ad.S. 1952. Recent finds of Lycodinae in Greenland waters. On the Greenland species of the genera *Artemiellus*, *Cottunculus*, and *Gymnocanthus* (Teleostei, Scheroparei, Cottidae). Medd. Grønland 142(7):1-28; 1-21.

Consists of distributional and taxonomic notes.

- Sekerak, A.D. and F.F. Graves. 1975. Investigation of aquatic resources along proposed Polar Gas pipeline routes north of Spence Bay, N.W.T. 1974. Vol. I. Unpubl. Rept. by Aquatic Environments Ltd. to Polar Gas Project. 186 pp.

Nineteen lakes along the proposed Polar Gas pipeline route were surveyed in late winter to determine their chemical and physical characteristics, mainly oxygen content and ice depth. In the summer a large number of lakes and streams were surveyed for fish, discharge, water quality and benthic macro-invertebrates. More detailed studies were conducted at Nelson and Victory Lakes near Resolute and Crooked Lake on Prince of Wales Island. Important anadromous Arctic char populations within our study area north of Boothia Peninsula were identified at the Union River, Somerset Island, and near southern Brentford Bay. These two areas were previously known to support anadromous char (see C.W.S. 1972), and the Union River population was studied by Sekerak *et al.* (1976a) as part of a more general study of Creswell Bay. Most deep lakes capable of supporting overwintering fish were found to contain Arctic char.

Other Studies of Arctic Char

The following studies on Arctic char have all been conducted considerably south of Lancaster Sound and adjacent waters. They are listed here as perhaps having some applicability because of the scarcity of this type of information for our study area and because of their recent nature.

- Moore, J.W. and I.A. Moore. 1974. Food and growth of Arctic char, *Salvelinus alpinus* (L.), in the Cumberland Sound area of Baffin Island. J. Fish Biol. 6:79-92.
- Moore, J.W. 1975a. Reproductive biology of anadromous Arctic char, *Salvelinus alpinus* (L.), in the Cumberland Sound area of Baffin Island. J. Fish Biol. 7:143-151.
- Moore, J.W. 1975b. Distribution, movements, and mortality of anadromous Arctic char, *Salvelinus alpinus* (L.), in the Cumberland Sound area of Baffin Island. J. Fish Biol. 7:339-348.

ORNITHOLOGY

The emphasis in this section is on species of seabirds and waterfowl that spend all or part of their stay in the area in marine and coastal habitats. Only brief mention is made of species that rarely occur in the marine habitats of the study area.

The major studies of seabird distribution in Barrow Strait, Wellington Channel and Prince Regent Inlet are reported in Davis *et al.* (1974), Alliston *et al.* (1976), Finley and Bradstreet (1977), and Nettleship and Gaston (1977); in Lancaster Sound the only major study is Johnson *et al.* (1976a). The best review of seabird colonies is provided by Brown *et al.* (1975). More recent and accurate estimates for the major seabird colonies in Barrow Strait and W Lancaster Sound are presented in Nettleship and Gaston (1977). The best estimates of Glaucous and Thayer's Gull populations in the study area are provided by Alliston *et al.* (1976) and Nettleship (1974a).

The most detailed studies of the food habits of sea-associated birds in the study are by Alliston *et al.* (1976) for Creswell Bay, by Bradstreet (1976) for E Lancaster Sound, Nettleship (1976) for Prince Leopold Island, and Bradstreet and Finley (1977) for ice-edges in Barrow Strait and Wellington Channel. Only two seabird colonies have been intensively studied: Cape Hay, Bylot Island (Tuck 1960) and Prince Leopold Island (Nettleship 1976; Nettleship and Gaston 1977).

Additional reports on birds in the study area also appear under the section 'Ornithology and Mammalogy'.

- Alliston, W.G., M.S.W. Bradstreet, M. McLaren, R.A. Davis and W.J. Richardson. 1976. Numbers and distribution of birds in the central Canadian Arctic: June-August 1975. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 584 pp.

This report presents the results of the research conducted in 1975 on the status of birds in the central Arctic Islands and Boothia Peninsula; it is part of the environmental program of the Polar Gas Project. The study was designed to complement similar studies conducted in the same area in 1974 (Davis *et al.* 1974, 1975); this report compares and summarizes the results from both 1974 and 1975. The main areas studied were eastern Melville Island, Byam Martin Island, southern Bathurst Island, Cornwallis Island, extreme southwest Devon Island, northeast Prince of Wales Island, Somerset Island, the Boothia Peninsula and adjacent channels. This study provides the most comprehensive information available about birds in the western portion of the area of concern to this bibliography.

Study Design

This study was designed to document bird distribution and to find and evaluate important areas and habitats for birds.

The surveys were of three types: ground, helicopter and fixed-wing aircraft. Information about the diets of certain species was also obtained by stomach-content analysis of specimens collected at Creswell Bay, Somerset Island, in 1975. The surveys of primary interest to this review are the systematic fixed-wing surveys of coastal and pelagic areas (including ice-edges). Indices of abundance were thus determined for each bird species in each area; these were utilized in evaluating the importance of various areas to birds. The surveys were extensive and irregular in schedule (rather than intensive and regularly repeated), due to the large study area and the logistic limitations. Hence, while much quantitative information was gathered (much of which was site-specific), no overall population estimates for birds were made. Fixed-wing surveys were conducted from early June to late August in both 1974 and 1975, with the exception that there were few such surveys in July 1974.

Details of the extent and intensity of survey coverage are only summarized in this report and in Davis *et al.* 1974 and only summaries of the survey results are presented.

Results are summarized here for Wellington Channel, Barrow Strait and Prince Regent Inlet. These results are first discussed in terms of individual species and then more briefly by specific area. Only those species or groups which are common in pelagic or coastal habitats are discussed. The results of research in terrestrial areas are outside the scope of this annotation and are excluded.

Ice conditions were very different during the 1974 and 1975 field seasons. In June of 1974, East Barrow Strait was clear of ice west to approximately a line from Resolute Bay to Limestone Island. In 1975 the ice-edge from late May until late June was between Maxwell Bay, Devon Island, and Cape Clarence, Somerset Island; the area west of this ice-edge was covered by fast-ice until late June in 1975. This difference in ice conditions, combined with the retarded spring of 1974 and the early spring of 1975, were major factors in causing differences in bird distribution between the two years.

Major Findings

Northern Fulmar

In June 1974, concentrations of up to 571 fulmars/sq mi occurred along the SW coast of Devon Island near Cape Hurd. In the spring of 1975, peak concentrations (522 individuals/sq mi) occurred nearby in leads adjacent to the Cape Liddon (SW Devon Island) fulmar colony. In June 1975, fulmars also concentrated along the fast-ice edge between NE Somerset and SW Devon Island; peak density of 147 fulmars/sq mi along this interface on 23 June. Northern Fulmars occurred in high densities near ice-edges but preferred the edges of pack-ice to fast-ice edges.

In August, fulmars dispersed widely following ice break-up with the largest concentrations occurring again adjacent to the Cape Liddon colony (maximum total of 11,221 seen between Waldegrave Bluff and Cape Riley on 21 August 1975; maximum density of 1175.7 individuals/sq mi at Waldegrave Bluff on that date), near the Prince Leopold Island colony (peak density 773.8 fulmars/sq mi on 20 August 1974) and along the south and east coasts of Cornwallis Island (peak density 155.9 individuals/sq mi on 8 August 1975). Concentrations of more than 50 individuals/sq mi were recorded in one or both years at various locations along the coast of E and N Somerset Island south to Bellot Strait and west to NE Prince of Wales Island.

Two colonies are located in the area: Prince Leopold Island and Cape Liddon, Devon Island (see Nettleship and Gaston 1977). Because of research being conducted on Prince Leopold Island in 1975, no aerial surveys were flown at that location.

Snow Goose

Snow Geese nested on Somerset Island and northeast Prince of Wales Island. The single most important breeding area was the vicinity of Creswell Bay, Somerset Island, where a maximum of 528 adults with 786 young were noted in 1975; an additional 1236 adults moulted in the area. The number of Snow Geese inhabiting other areas on Somerset Island was considerably smaller (in 1975, 158 adults with young). In 1974, few broods were produced but an estimated 2700 adults were present on the Creswell River and 575 were observed elsewhere on SE Somerset Island on 26 July (J.D. Heyland, Quebec Wildlife Service, pers. comm).

Oldsquaw

The Oldsquaw occurred commonly along coasts and ice-edges within the study area. A total of 1849 Oldsquaw were seen on 4 June 1974 along the north mid-coast of Somerset Island. On 5 June, 520 were present along the Wellington Channel ice-edge from Depot Pt. to Cape Riley. No major concentrations were noted during the spring in 1975. Large concentrations, many of

which were moulting birds, were observed in late July and August of 1974 and 1975; the largest numbers were present along the north coast of Creswell Bay (2664 on 24 August 1974; 2287 individuals on 10 August 1975), and along the north coast of Somerset Island (1554 individuals on 19 August 1975).

Eiders

Both Common and King Eiders occur in the areas of Barrow Strait, Prince Regent Inlet and Wellington Channel. The ratio of Common:King Eiders identified in spring 1974 was 1:2; in 1975 it was 1:5.2. In spring, the largest concentrations of Common Eiders within the area of concern occurred along the shores and ice-edges of East Barrow Strait in 1974 (when this area was ice-free) and on the east coast of Somerset Island in 1975 (when East Barrow Strait was ice-covered). Peak numbers seen on single transects during spring were 2471 near Depot Point, E Cornwallis Island, on 5 June 1974 and 626 near Elwin Bay, E Somerset Island on 16 June 1975.

Similarly, in 1974 King Eiders were abundant along coasts of East Barrow Strait but not along most of the east coast of Somerset Island, whereas in 1975 they were abundant in the latter area but in East Barrow Strait were largely confined to a polynia to the west of Cunningham Inlet. Peak concentrations of King Eiders recorded in June 1974 in the area of concern to this bibliography included 4457 along the north coast of Somerset Island near Garnier Bay on 8 June and 1036 along the east coast of Cornwallis Island on 7 June. Peak concentrations recorded in June 1975 included 3684 in the above-mentioned polynia near Cunningham Inlet, N Somerset Island, on 12 June; 1781 near Elwin Bay, E Somerset Island, on 3 June; and 1455 near Fury Point, E Somerset Island, also on 3 June. A recurrent polynia at the eastern end of Bellot Strait was of particular importance in both years [6264 King Eiders seen there on 21 June 1974 and 9200 eiders (both species) seen there on 3 June 1975].

In late summer of 1975 broods of eiders (not identified to species) were widely distributed in the study area. In total, 308 young were seen along

the N and NE coasts of Somerset Island, 245 along the S, E and N coasts of Cornwallis Island and 144 along the SW coast of Devon Island. These results indicate that eiders nest in many parts of the study area.

Large concentrations of eiders were found in late summer, particularly in the first ten days of August in 1974. After the largely unsuccessful breeding season of 1974 many thousands of eiders gathered along the SE coast of Somerset Island (18,288 seen on 5 August), at Creswell Bay (5,441 seen on 10 August) and near Garnier Bay along the N coast of Somerset Island (13,023 seen on 11 August). In 1975 many eiders remained scattered along coasts or inland with their broods, and concentrations were generally smaller (maxima of 3237 seen along the SE Somerset, 7228 at Creswell Bay, few near Garnier Bay). Numbers in the main concentration areas had decreased by late August.

Shorebirds

The only area where shorebirds were known to concentrate in intertidal or estuarine areas was near the mouth of the Creswell River, Creswell Bay. The maximum number of individuals observed at one time was 12,000 (mostly immatures) on 21 August 1975; a rapid turnover rate was suggested and therefore it is likely that many more shorebirds utilize the area during the course of a season.

Glaucous Gull

Glaucous Gulls were widespread in all areas of concern to this bibliography; with few exceptions, the largest concentrations recorded on aerial surveys were along coastlines adjacent to colonies. The numbers of pairs nesting along the coastlines adjacent to Wellington Channel, Barrow Strait, Prince Regent Inlet and Peel Sound are given in Table a.

Thayer's Gull

The distribution of nesting pairs along coasts of Barrow Strait, Wellington Channel, Prince Regent Inlet and Peel Sound is given in Table a.

The largest concentrations noted during aerial surveys were located in the vicinity of the breeding colonies.

Table a. Numbers of Pairs of Nesting Glaucous, Thayer's and Unidentified Large Gulls on Coasts of Islands Adjacent to Wellington Channel, Barrow Strait and Prince Regent Inlet, 1974-1975.¹

	<u>Glaucous Gull</u>	<u>Thayer's Gull</u>	<u>gull sp.</u>
Lowther I.	20	-	5
Griffith I.	-	5	-
Browne I.	16	100	1
Bathurst I. (S coast)	1	-	-
Cornwallis I. (S coast)	29	-	-
Cornwallis I. (E coast)	80	10	-
Devon I. (SW coast to E of Maxwell Bay)	293	-	5
Somerset I. (N coast)	47	90	20
Somerset I. (E coast incl. Bellot Strait)	61	655	2
Russell I.	59	-	30
Prince Leopold I.	200	-	-
Total	894	1029	128
Peel Sound-coasts	88	169	65

¹These represent maximum estimates for 1974 or 1975.

Ivory Gull

Ivory Gulls were rather uncommon throughout the area except at Resolute where a group of 112 was seen at the dump on 4 September 1975. None of about 15 young-of-the-year that were closely examined was banded. S. MacDonald

(pers. comm.) banded all young that hatched at Seymour Island--the one known active colony in Canada--in 1975. Thus it is very likely that there is another active colony in the central Canadian Arctic (see also Finley and Johnston 1977).

Black-legged Kittiwake

In the central Arctic, kittiwakes are found only in a few large colonies: 125 pairs at Separation Point, E Cornwallis Island; about 29,000 pairs on Prince Leopold Island; 2000 pairs near Batty Bay, E Somerset Island; and 2000 pairs on Browne Island (Nettleship 1974; Davis *et al.* 1974; Alliston 1976; Nettleship and Gaston 1977). Additional colonies totalling about 2000 pairs are also found on Baillie-Hamilton Island.

Most concentrations during migration occur adjacent to the major colonies--i.e., eastern Somerset Island and Browne Island. During 1974, large concentrations also occurred along SW Devon Island (1430/sq mi, on 29 June near Cape Hurd). Creswell Bay was an important area for kittiwakes during August (maximum 1496 on 24 August 1974).

Arctic Tern

The Arctic Tern was widely distributed in coastal areas. A concentration occurred along the S coast of Cornwallis Island in the spring of 1974 (684 seen on 29 June). Numbers were often high in the McDougall Sound and Creswell Bay areas; smaller but significant numbers were also found along the north coast of Somerset Island. In 1974, a flock of 600 was seen at a polynia in Creswell Bay on 12 July, and 503 were seen there on 18 June 1975. An estimated 145 to 155 pairs of Arctic Terns nested in Creswell Bay and adjacent areas in 1975.

Thick-billed Murre

The only colony of this species within the Polar Gas study area, at Prince Leopold Island, was not surveyed by Alliston *et al.*; hence the concentrations noted during aerial surveys were not in the immediate vicinity of this colony.

In 1974, when East Barrow Strait was clear of ice by late May, the largest spring concentration was recorded along the Wellington Channel ice-edge between Depot Point and Cape Riley (723 murre/sq mi, seen on 18 June). The floe edge between Resolute Bay and Griffith Island was also important (407/sq mi, on 29 June). In 1975, the area of major importance during spring was the ice-edge between Cape Clarence and Maxwell Bay; the highest densities (1210 birds/sq mi) were along a 12-mile section of ice-edge nearest Prince Leopold Island on 16 June. Large concentrations of >100 individuals/sq mi were also recorded along the coast of Somerset Island near Elwin Bay.

Following ice break-up in July 1975, the Wellington Channel ice-edge was the single most important area; a total of 8843 individuals (1352 individuals/sq mi) were recorded here on 7 July. All other concentrations were significantly smaller and no densities exceeding 70 birds/sq mi were recorded elsewhere. In August most murre seen were near the Prince Leopold Island colony, but the colony itself was not surveyed and no major concentrations were recorded.

Black Guillemot

During June 1974, concentrations in excess of 50 guillemots/sq mi were recorded in two main areas--along the southwest coast of Devon Island and the Wellington Channel ice-edge. During June 1975, when East Barrow Strait was largely ice-covered, guillemots concentrated in leads and cracks along the SW coast of Devon Island and also along eastern Somerset Island. After the fast-ice left East Barrow Strait in late June of 1975, guillemots also concentrated along the West Barrow ice-edge between Griffith Island and Prince of Wales Island and along the Wellington Channel ice-edge. In 1974, the maximum June concentrations occurred along SW Devon Island between Cape Riley and Cape Hurd (109/sq mi). In 1975, the maximum June concentration occurred in a lead from Cape Liddon across Maxwell Bay (143 individuals/sq mi). Other major concentrations occurred along the entire Wellington Channel ice-edge on 18 June 1974 (53/sq mi) and along the fast-ice edge NE of Prince Leopold Island on 23 June 1975 (59/sq mi).

During July 1975, the largest concentration (1018 birds; 158/sq mi) occurred along the Wellington Channel ice-edge between Innes Point and Depot Point. All other areas supported densities of less than 90 birds/sq mi. A significant number (767 individuals) were recorded near the NE coast of Prince of Wales Island from Lyons Point to Pressure Point on 7 July.

No large concentrations (all <42 /sq mi) were recorded in August 1974. The largest numbers noted during the entire study were recorded during August 1975. Along the E coast of Somerset Island, a total of 3296 individuals (281/sq mi) were recorded between Batty Bay and Fury Beach on 10 August, and 752 individuals (285/sq mi) were recorded between Cape Seppings and the river 8 mi N of Elwin Bay on 21 August. These represented birds at or near colonies. The numbers of nesting Black Guillemots cannot be reliably assessed during fixed-wing aerial surveys. The main nesting areas were along coasts of East Barrow Strait and northern Prince Regent Inlet.

Important Areas for Birds

During both years of the study, East Barrow Strait contained greater numbers and concentrations of birds than any other sector of the Polar Gas study area. The two largest seabird colonies in the central Arctic are both found in East Barrow Strait: Prince Leopold Island--Northern Fulmars, Black-legged Kittiwakes, Thick-billed Murres and Black Guillemots (see Nettleship and Gaston 1977) and Cape Liddon--Northern Fulmars (Nettleship 1974b).

During June and July in 1974 and 1975, fast-ice edges were important areas for several pelagic species, particularly Northern Fulmars, Thick-billed Murres and Black Guillemots. The most important ice-edges were between NE Somerset Island and Maxwell Bay, Devon Island; across the mouth of Wellington Channel; and near Resolute Bay, Cornwallis Island. Prior to general ice break-up in late July and August, all important ice-edges were located in Barrow Strait.

Table b. Numbers of Nesting Pairs of Six Species of Birds along Coasts in Seven Sectors of the Central Canadian Arctic¹.

	Northern Fulmar	Glaucous ² Gull	Thayer's ² Gull	Black-legged Kittiwake	Thick-billed Murre	Black Guillemot
Barrow Strait	72,700 ³	645	195	31,190	70,530	3,275
Peel Sound	-	80	8	-	-	1
McDougall Sound	-	8	-	-	-	-
Wellington Channel	-	80	10	125	-	8
Queens Channel	-	466	-	2,101	-	294
Prince Regent Inlet	-	61	280	2,000	-	1,703
Byam/Austin Channel	-	20	20	-	-	-

¹All estimates represent maximum numbers recorded in 1974 or 1975; from Alliston *et al.* (1976: Table 65), who summarize data from LGL Ltd. and Nettleship (1974, 1976).

²Inland colonies away from the influence of the sea were excluded.

³Cape Liddon colony estimated to contain at least 1000 pairs

The second important area was Prince Regent Inlet, which contained two of the major bird colonies in the area (Black-legged Kittiwake and Black Guillemot) as well as Creswell Bay. The latter area was very important for staging shore-birds, breeding and moulting Snow Geese, moulting Oldsquaw, staging eiders, and feeding fulmars and kittiwakes during either or both of 1974 and 1975.

Apart from the seabirds associated with the Wellington Channel ice-edge and the local concentrations of fulmars along the east coast of Cornwallis Island during the ice-free period, Wellington Channel was of minor importance. The only bird colonies located along the coasts were small colonies of Glaucous Gulls, Thayer's Gulls and Black Guillemots, and one relatively small colony of Black-legged Kittiwakes.

In summary, the areas of primary importance for sea-associated birds within the Polar Gas study area were located mostly within East Barrow Strait, Prince Regent Inlet and the mouth of Wellington Channel. These areas included

1. Wellington Channel ice-edge
2. Griffith Island-Resolute Bay ice-edge
3. NE Somerset Island-Maxwell Bay ice-edge
4. SW coast of Devon Island (to east of Maxwell Bay)
5. N coast of Somerset Island (from Cunningham Inlet to Cape Clarence)
6. E coast of Somerset Island (from Cape Clarence to Bellot Strait including all of Creswell Bay).

It should be noted that these are all restricted areas of concentration. The surveys were not designed to permit estimation of total numbers in wide areas, and it is possible that total numbers of certain seabird species using the extensive offshore area of East Barrow Strait would exceed total numbers using the much smaller concentration areas.

● Barry, T.W. 1960. Waterfowl reconnaissance in the Western Arctic. The Arctic Circular 8(4):51-58.

This paper provides population estimates of waterfowl and seabirds in several areas of the western and central arctic as determined from aerial surveys flown in 1958 and 1960. Areas visited that are included in this bibliography were south-central Devon Island, NW Baffin Island, Somerset Island and Prince of Wales Island. Within these areas, estimates are presented for only two regions:

1. Somerset Island--800 Snow Geese [see Alliston *et al.* 1976 for most recent estimates].

2. Prince Leopold Island and Limestone Island--150,000 Northern Fulmars (including Cape Clarence on Somerset Island), 3000 Glaucous Gulls, 180,000 Black-legged Kittiwakes, 350,000 murrees and 4000 Black Guillemots. [See Nettleship and Gaston 1977 for the most recent estimates for Prince Leopold Island; Davis *et al.* (1974) and Alliston *et al.* (1976) found only Black Guillemots and Glaucous Gulls nesting at Limestone Island in 1974 and 1975.]

● B.C. Research. 1975. Baseline survey of the marine environment at Strathcona Sound, N.W.T. Progress Report 1. Unpubl. Rept. to Strathcona Mineral Services. 84 pp.

This study was designed to assess the physical and biological characteristics of Strathcona Sound and adjacent regions; the main information about birds concerned the status of seabird colonies in the area. Seabird surveys were conducted in the area from 27 July to 1 August 1975. [Additional information about birds in this area is reported by Kemper (1976).]

Major Findings

Six gull colonies were known or suspected; these included 97 pairs of Glaucous Gulls and 105 pairs of Thayer's Gulls in 3 colonies in Adams Sound; 15 Glaucous Gulls and 85 Thayer's Gulls in one colony in Strathcona Sound and 23+ Glaucous Gulls in two colonies between Baillarge Bay and Elwin Inlet.

Ten census plots were set up on the cliffs at the Northern Fulmar colony at Baillarge Bay. The plots varied in size from 900 to 20,000 square feet of cliff face (the size of one plot was not given). A total of 315-321 breeding pairs were counted on the 62,100 square feet within 9 plots. Due to the heterogeneity of conditions on the cliffs and the relatively small area surveyed, no population estimates were made for the entire colony.

Bradstreet, M.S.W. 1976. Summer feeding ecology of seabirds in Eastern Lancaster Sound. Unpubl. Rept. by LGL Ltd. to Norlands Petroleum Ltd. 187 pp.

This report presents data on the summer feeding ecology of Northern Fulmars, Black-legged Kittiwakes, Thick-billed Murres, Dovekies and Black Guillemots collected in Lancaster Sound from 22 July to 13 September 1976 and on birds and marine mammals observed during 10-minute seawatches from the research vessel 'Theta' during the same period. The food studies are based on 610 specimens collected in Eastern Lancaster Sound, usually in the vicinity of zooplankton sampling stations (see Sekerak *et al.* 1976b). A total of 170 seawatches were conducted at various zooplankton sampling locations in Lancaster Sound.

Methods

Standard collecting and preserving techniques were employed in the food studies. Unlike most previous authors, Bradstreet calculated sizes and weights of organisms at the time of ingestion rather than use weights of partially-digested fragments or mere counts of organisms present. The diet of each bird species was expressed in three ways: (1) number of individuals of each organism or group as a percent of the total number of organisms present, (2) percent wet weight of each organism or group, and (3) percent dry weight of each organism or group. These methods provided different indications of the relative importance of each food type, primarily because of the great variation in the sizes of various types of organisms. These differences were evident among all three methods but especially between percent occurrence and percent wet and dry weights. The caloric importance of each major type of food to each bird species is briefly discussed. Information is presented on sizes of each organism ingested by each bird species. For each food taxon, the relative utilization by each bird species is also summarized.

The seawatch methods were similar to those described and used in Lancaster Sound and vicinity by Brown *et al.* (1975).

The following additional material has become available since the first printing of this bibliography.

Major Findings

The seawatches provided little quantitative information regarding seabirds; the findings in terms of mean number of seabirds seen per watch did not differ markedly from those of Brown *et al.* (1975) with the exception of data for Thick-billed Murres. The mean numbers of murres recorded per seawatch in 1976 was somewhat higher than that given by Brown *et al.* (1975). Directional movement toward or away from the Cape Hay Black-legged Kittiwake colony was indicated in East mid-Sound and Navy Board Inlet.

Figure a (from Bradstreet) summarizes the general composition of the diets of the five species of seabirds studied. The values at the left of the diagram are the numbers of individual birds collected whose stomachs contained food items.

For fulmars, the energy intake from fish (primarily Arctic Cod) was 63% of total intake. Amphipods represented an additional 31% (Figure a). Numerically, fish were relatively unimportant; 800 invertebrates were taken for every fish taken.

For kittiwakes, 97% of the energy intake was from fish; this was the highest value for the five species studied. The ratio of # invertebrates taken/# fish taken was 142.

The relative energy input of various food groups was very similar for the Thick-billed Murre and Black Guillemot; the energy content of their respective diets averaged 88% and 87% fish; most of the remaining energy intake was from amphipods.

The Dovekie was the one species whose energy intake was by amphipods, which accounted for about 65% of the energy input. Fish represented only 35% of the energy input.

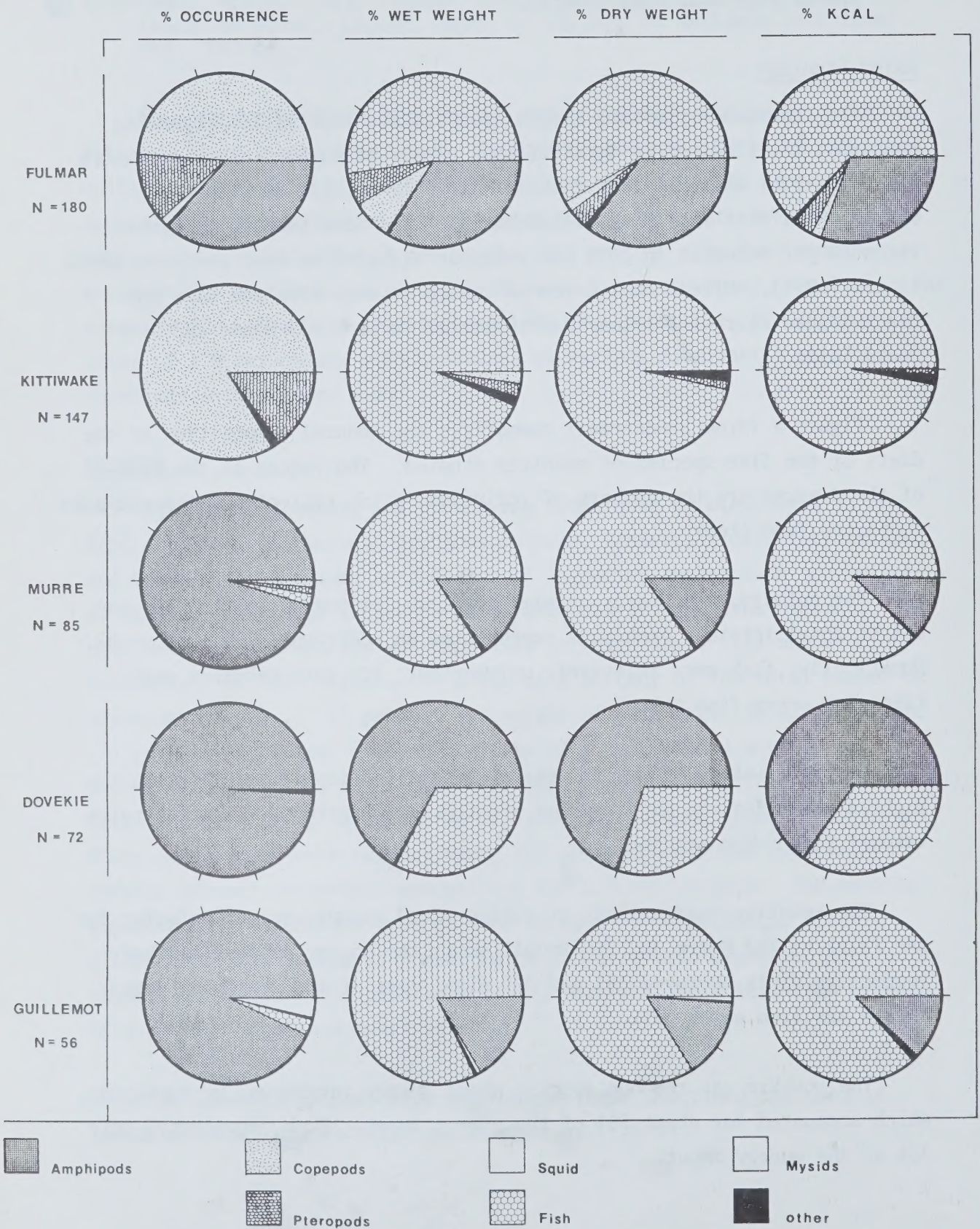


Figure a. Summary of the Importance of Major Food Taxa in the Diets of Seabirds Collected in Lancaster Sound, 1976.

Parathemisto spp. were the most important amphipods in the diets of seabirds in Lancaster Sound; this group made up 57% of the amphipod dry weight in fulmars, 96% in murre, 49% in Dovekies and 40% in guillemots. Other amphipods commonly found in the stomachs are identified in Figure B.

It is concluded that fulmars were selecting for invertebrates but were taking fish opportunistically. The four seabirds that gained their primary source of energy from Arctic Cod (fulmar, kittiwake, murre and guillemot) apparently had an alternate food supply, primarily amphipods.

- Bradstreet, M.S.W. 1977. Feeding ecology of seabirds along fast-ice edges in Wellington Channel and Resolute Passage, N.W.T. In: A.D. Sekerak (ed.), Studies of the ecology of fast-ice edges in the High Arctic. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. (in prep.)

This study investigated the feeding ecology of birds associated with ice-edges in Wellington Channel and Resolute Passage during June and early July 1976. The main species studied were Black-legged Kittiwake, Thick-billed Murre and Black Guillemot.

Methods used in this study were similar to those described in Bradstreet (1976). The importance of various food taxa in the diet of each bird species are presented in terms of percent occurrence, percent wet-weight and percent dry-weight. The diets of murres and guillemots collected in different areas of the ice-edge are compared and, in the case of the amphipod component of the diet, related to the food available in the water column near the ice-edge.

Analyses are not yet complete. Early results indicated that Arctic cod were of greater importance (in terms of percent of total dry-weight) to murres and guillemots along the ice-edges studied than they were later in the same season in eastern Lancaster Sound (Bradstreet 1976).

- Bradstreet, M.S.W. and K.J. Finley. 1977. Distribution of birds and marine mammals along fast-ice edges in Barrow Strait, N.W.T. In: A.D. Sekerak (ed.), Studies of the ecology of fast-ice edges in the High Arctic. Unpubl. Rept. by LGL Ltd. to Polar Gas Project.

The importance of ice-edges to birds in the Barrow Strait area was studied in conjunction with marine sampling in the spring of 1976; this report also considers all aerial surveys conducted by LGL along ice-edges in the area during 1974 and 1975 (Davis *et al.* 1974, 1975; Alliston *et al.*

1976). East Barrow Strait was free of ice during most of June 1974 and 1976; in 1975, fast-ice remained in East Barrow Strait until late June. The situation in 1975 is the more typical spring ice condition. Therefore, there was opportunity to study the variable use that seabirds made of the different spring ice conditions present during the three years. Bird distribution was studied on three levels:

1. the affinity for landfast ice-edges and sea ice-edges relative to the open ocean;
2. the dispersion of birds along ice-edges, and
3. the distribution of birds relative to distance from the ice-edges.

In addition, the chronology of bird movements into the study area was documented and the relative importance of various geographic sectors (e.g., Wellington Channel, coast of Cornwallis Island) was determined. Because the analysis is not yet complete, the following summary is necessarily tentative and incomplete.

Some Findings

Many species of birds were more concentrated along ice-edges (both landfast ice-edges and sea ice-edges) than in open sea habitat. Based on 1974 data, the degree of preference for ice-edge habitat varied among species. Densities of Northern Fulmars averaged six times as high along ice-edges as in open sea, while eider densities were 342 times as great along ice-edges as in open sea. Thick-billed Murres and Black Guillemots were nine times as concentrated along ice-edges. Brant, Common Eider and Arctic Terns were never observed during transects over open sea. Furthermore, most species seemed to concentrate directly along the ice-edge as densities of birds from 0-200 m off the ice--water interface were generally higher than were densities in areas 200-400 m from such interfaces.

There were three main patterns of abundance along the ice-edges. Some species were common by early June, then declined in abundance by mid or late June (e.g., Brant, Glaucous Gull). Other species increased in abundance during June (e.g., Northern Fulmar, Arctic Tern, Thick-billed Murre). A third pattern was established by species which were uncommon in early June, increased during mid-month then had decreased again by late June (e.g., all eiders).

- Brown, R.G.B., D.N. Nettleship, P. Germain, C.E. Tull and T. Davis. 1975. Atlas of eastern Canadian seabirds. Canadian Wildlife Service, Ottawa. 220 pp.

This atlas summarizes the nesting and pelagic distributions of all bird species that occur in marine environments of West Greenland, the Canadian eastern Arctic, and eastern Canada. Bird colony information and ranges are mostly summarized from existing published and unpublished information; the pelagic distributions are the result of original research conducted by PIROP and the Canadian Wildlife Service from 1969 to 1973. The information is used to map areas of seabird vulnerability; these maps may be used in impact assessment in the areas studied.

Major Findings

The locations and sizes of Northern Fulmar, Black-legged Kittiwake and Thick-billed Murre colonies in the area of concern to this bibliography are listed in Table a. Six of the 13 presently occupied Northern Fulmar colonies in Arctic Canada are located within the area of concern; these contain an estimated 210,000 pairs of breeding birds. The remaining colonies contain an additional 137,000 pairs (no estimates are available for two colonies on Coburg Island and one colony off SE Baffin Island). The largest colony in the area is located in western Lancaster Sound at Hobhouse Inlet, southern Devon Island; it is estimated to contain 150,000 pairs. [This colony has recently been re-assessed and the current provisional estimate is about 70,000 birds (Nettleship and Gaston 1977).]

Seven Black-legged Kittiwake colonies are reported from the area; these include about 110,000 pairs (Table a). [The colony at Separation Point was not occupied in 1974 or 1975 (Alliston *et al.* 1976) and kittiwakes did not nest at Wollaston Island in 1976 (Johnson *et al.* 1976). An additional colony of about 2000 pairs has been reported from Batty Bay, E Somerset Island (Alliston *et al.* 1976).]

Twelve other kittiwake colonies located in the eastern Arctic are apparently relatively small (there are no estimates for four of these); the largest is 3000 pairs. Thus, the eight colonies in the area probably represent over 90% of the kittiwakes which nest in the Canadian Arctic. The kittiwake colonies at Cape Hay (50,000 pairs) and Prince Leopold Island [about 30,000 pairs (Nettleship and Gaston 1977)] are the largest kittiwake colonies in eastern North America including Greenland.

Three of the 11 certainly known Thick-billed Murre colonies in the eastern Canadian Arctic are located in the area of concern; together these are estimated to include 495,000 pairs. The colony estimated to contain 400,000 pairs of Thick-billed Murres is located near Cape Hay, Bylot Island, and was one of the four largest Thick-billed Murre colonies in the northwest Atlantic. However, recent surveys have indicated a decline since the initial estimate in 1957. The authors suggest that declines have occurred at several major murre colonies in the eastern Arctic.

Black Guillemot colonies and single pairs occur on coastlines throughout most of the area of concern. The largest concentration is located on Prince Leopold Island in western Lancaster Sound (2000 pairs).

The seabird vulnerability maps for July/August indicate that large pelagic concentrations occur off southeast Devon Island (from west of Croker Bay to Philpots Island) and in Eclipse Sound. Medium pelagic concentrations

Table a.
Colonies of Northern Fulmar, Black-legged Kittiwake and Thick-billed Murre in Lancaster Sound and area.¹

Species	Colony Location	Position	Colony Size ²	Census Year	Authority
Northern Fulmar	Cape Liddon, Devon I.	74°37'N, 91°13'W	+10,000p (order 4)	1972	Nettleship 1974a,b
	Hobhouse Inlet, Devon I.	74°27'N, 86°53'W	+75,000p (order 5)	1972	Nettleship 1974a,b
	Prince Leopold I.	74°02'N, 90°00'W	+50,000p (order 5)	1972	Nettleship
	Baillarge Bay, Baffin I.	73°25'N, 84°30'W	+25,000p (order 5)	1972	Nettleship
	Buchan Gulf, Baffin I:				
	east colony (The Bastions)	71°50'N, 74°13'W			
	mid colony	71°47'N, 74°38'W	+25,000p (order 5)	1973	Nettleship
	west colony (The Mitres)	71°45'N, 74°42'W			
	Scott Inlet, Baffin I.	71°02'N, 71°08'W	+25,000p (order 5)	1973	Nettleship
Black-legged Kittiwake	Washington Point, Baillie-Hamilton I.	75°46'N, 94°17'W	+ 3,000p	1973	Nettleship 1974b
	Separation Point, Cornwallis I.	75°07'N, 93°29'W	125p	1972	Nettleship 1974b
	Browne I.	74°49'N, 96°22'W	+ 1,000p	1972	S.D.MacDonald, pers. comm.
	Prince Leopold I.	74°02'N, 90°00'W	+50,000p	1972	Nettleship
	Wollaston I.	73°43'N, 80°57'W	+ (order 3)	1973	Nettleship
	W of Cape Hay, Bylot I.	73°46'N, 80°23'W	50,000p	1957	Tuck and Lemieux 1959
	Cape Graham Moore, Bylot I.	72°56'N, 76°02'W	3,000p	1957	Tuck and Lemieux 1959
Thick-billed Murre	Prince Leopold I.	74°02'N, 90°00'W	+75,000p	1972	Nettleship
	W of Cape Hay, Bylot I.	73°46'N, 80°23'W	400,000p ¹	1957	Tuck 1961
	Cape Graham Moore, Bylot I.	72°56'N, 76°02'W	+20,000p (order 5)	1972	Nettleship

¹ From Brown *et al.* 1975.

² order 3 = 100-999p, order 4 = 1000-9999p, order 5 = 10,000-99,999p.

occur in the vicinity of Coburg Island, at the west end of Jones Sound, and along the east and northeast coasts of Bylot Island. In the September/October period, large concentrations occur from eastern Bylot Island across much of northern and central Baffin Bay; medium concentrations occur from Coburg Island southeast to south-central Baffin Bay.

[The lack of coverage in the eastern Arctic during May and June leaves a large gap in the map of seabird vulnerability. During this period seabirds migrate northward and arrive in ice-infested waters near the colonies; hence they may be more concentrated in the available open water than during any other time of the year and are therefore more vulnerable to the effects of disturbance and pollution. Johnson *et al.* (1976) and Alliston *et al.* (1976) provide recent spring observations relevant to this point.]

- Dalgety, C.T. 1936. Notes on birds observed in Greenland and Baffin Land. *Ibis* 78:500-591.

This paper contains notes on birds observed in Greenland and Baffin Island; the Baffin coast between Eglinton Fjord and Clyde Inlet was visited from 14 to 29 August 1934. Dalgety observed large numbers of King Eiders at Cape Eglinton on 14 August (1000 individuals) and 20 August (1500 to 2000). Other large flocks were seen in Clyde Inlet. Almost all the birds observed were adult females. No significant quantitative information is given about other species observed.

- Davis, R.A., C. Holdsworth, and W.J. Richardson. 1973. Present ornithological knowledge and suggested research programs for the Polar Gas pipeline project. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 245 p.

This survey consisted of an exhaustive literature review and interviews of researchers and scientists who are familiar with parts of the Polar Gas study area (north to E Melville Island, Ellef Ringnes Island and N Axel Heiberg Island, and south to James Bay to include both coasts

of Hudson Bay, NE District of Keewatin, Boothia Peninsula, Prince of Wales Island, Somerset Island, Cornwallis Island, Bathurst Island, W Devon Island, SW Ellesmere Island and adjacent small islands). The existing information was synthesized into accounts of the bird species known to occur in the area. The major gaps in the knowledge of each species in this area were identified and future survey and research requirements were discussed. Sections are included on the philosophy and methodology of the suggested research design.

Major Findings

Knowledge of bird distribution in the area is relatively good. However, there is an almost total lack of quantitative information, and the knowledge of bird concentrations is considered to be inadequate.

- Davis, R.A., M. Bradstreet, C. Holdworth, M. McLaren and W.J. Richardson. 1974. Studies of the numbers and distribution of birds in central Canadian Arctic--1974: a preliminary report. Unpubl. Rept. by LGL Ltd. to Polar Gas Project (2 vol) 238 pp.

This report presents the results of the research conducted in 1974 on the status of birds in the central Arctic Islands and Boothia Peninsula. Similar studies were conducted in 1975, and the study design and results are discussed in the review of Alliston *et al.* (1976). Feeding studies were not undertaken in 1974.

- Drury, W.H., Jr. 1960. Breeding activities of Long-tailed Jaeger, Herring Gull and Arctic Tern on Bylot Island, Northwest Territories, Canada. Bird-Banding 31:63-78.

Drury documents and discusses aspects of the life histories of three species of arctic birds on southern Bylot Island based on field work from 12 June to 29 July 1954. [The 'Herring Gulls' studied by Drury are now considered to be members of a separate species, the Thayer's Gull.] The

topics discussed include arrival dates, migration, territory, behaviour and nest and egg descriptions.

Because this is primarily a study of arctic birds in the terrestrial environment, it is not of direct interest to this bibliography.

- Drury, W.H., Jr. 1961a. Observations on some breeding water birds on Bylot Island. *Can. Field-Naturalist*. 75:84-101.

This paper describes aspects of the life histories of the Red-throated Loon, Greater Snow Goose, Oldsquaw and King Eider; it is based on field work on southern Bylot Island from 12 June to 29 July 1954.

Drury describes behaviours associated with spring arrival and breeding and the status of relatively undisturbed populations. All species discussed, except the Greater Snow Goose, occupy marine areas during migration and are therefore greatly dependent on Baffin Bay and Eclipse Sound before suitable breeding habitat becomes available during June, and later during post-breeding dispersal and fall migration. Thus Red-throated Loons, King Eiders and Oldsquaw are vulnerable to activities in these waters.

- Drury, W.H., Jr. 1961b. The breeding biology of shorebirds on Bylot Island, N.W.T., Canada. *Auk* 78:176-219.

This paper describes and discusses aspects of the life histories of certain arctic species that nest on southern Bylot Island; the results are based on fieldwork on the north shore of Eclipse Sound between 12 June and 29 July 1954. This paper discusses the American Golden Plover, Black-bellied Plover, Ringed Plover, White-rumped Sandpiper, Baird's Sandpiper and Sanderling. The primary emphasis of the paper is on the comparative behaviour of different species, especially American Golden Plover *vs* Black-bellied Plover and White-rumped *vs* Baird's Sandpiper.

Because the emphases of this paper are on behaviour and terrestrial breeding biology, it is of secondary interest to this bibliography.

- Ellis, D.V. 1956b. Observations on migration, distribution and breeding of birds in the Canadian Arctic during 1954 and 1955. Dansk Orn. Foren. Tidsskr. 50:207-230.

This account consists of an annotated list of birds seen during field work conducted between Coppermine and Pond Inlet from May 1954 until August 1955. Ellis' work consisted of collecting marine animals, and birds were recorded only incidentally.

This paper presents important distributional information for many species whose ranges and dates of occurrence in the eastern Canadian Arctic are little known. Ellis' observations of spring migration at Button Point, eastern Bylot Island, and fall migration at Arctic Bay are important because little ornithological work has been done at these latitudes during these seasons. Although little quantitative information is presented, much detailed information is given about sightings of birds at each locality visited.

Important information is presented on the distribution of all species. Late fall departure dates were obtained at or near Arctic Bay for the Northern Fulmar (19 October), Oldsquaw (11 October), King Eider (18 October), Glaucous Gull (18 October) and Black-legged Kittiwake (15 October); it appears that these species remain in the eastern Arctic until ice-conditions force a southward movement.

The spring migration past Button Point, Bylot Island, in 1955 is documented but observations began rather late (16 May) and 6 species of birds were already present on that date (Northern Fulmar, King Eider, Glaucous Gull, Black-legged Kittiwake, Thick-billed Murre and Black Guillemot). It is of interest to note that no birds were seen at the floe-edge in Navy Board Inlet when investigated on 27 April.

- Evans, P. and G. Waterstan. 1976. The decline of the Thick-billed Murre in Greenland. *Polar Record* 18:283-293.

The decline of the Thick-billed Murre in Greenland is documented and discussed. There is also some reference to the influence of hunting in Greenland on populations that nest within Canadian arctic waters.

'The Lancaster Sound Murre population, which mainly winters in SW Greenland, is shot by Greenland hunters from October to May during migration and on the winter range, which mainly covers Egedesminde and Holsteinborg districts. About 160,000 birds of this population used to be shot annually (Salomonsen, 1970). The hunters from Fiskenaesset, a settlement south of Godthaab, stated that they had shot about 500 murres in the 1974 season--insufficient for their winter supply. Further reports indicate that this was the situation in many places along the coast in 1974.'

Recent legislation prohibiting shooting at Greenland colonies has been largely ignored.

It was concluded on the basis of other studies that commercial drift netting may kill up to 500,000 murres annually off SW Greenland (Tull *et al.* 1972) and this combined with hunting mortality may exceed annual production of Thick-billed Murres.

- Geale, J. 1971. Birds of Resolute, Cornwallis Island, N.W.T. *Can. Field-Naturalist* 85:53-59.

In this paper, Geale discusses the status of all birds known to have occurred at or near Resolute Bay, Cornwallis Island; he draws mainly from personal observations made from 14 May to 26 September 1969. He makes brief reference to published accounts of birds in the area. A total of 35 species are discussed.

The value of the report lies primarily in its contribution to the knowledge of bird distribution. Geale's daily observations, covering a

span of nearly $4\frac{1}{2}$ months, represent the longest period of continuous observations of birds on Cornwallis Island.

No systematic surveys for birds were completed; hence little quantitative information is presented. However, species are often related in abundance to one another and actual numbers, and distances travelled in which the numbers were seen, are frequently given.

Geale's major findings are in terms of previously-known range; he presents data for eight species for which no previous records existed from Cornwallis Island (Snow Goose, Ruddy Turnstone, White-rumped Sandpiper, Snowy Owl, Horned Lark, Barn Swallow, Common Raven and Lapland Longspur). Ivory Gulls were observed on 30 June (6 individuals), 9 September (1) and 12 September (6 adults, 1 immature).

- Godfrey, W.E. 1966. The birds of Canada. Nat. Mus. Canada Bull. 203:1-428.

This remarkable book is the most up to date review of the status and distribution of Canadian birds. It is not intended to provide numerical information. A revised edition is reportedly in preparation.

- Hørring, R. 1937. Birds collected on the Fifth Thule expedition. Rept. 5th Thule Exped. 1921-24 2(6):1-133 + 1 map. Copenhagen.

This volume lists the bird specimens collected by P. Freuchen, H. Bangsted and K. Rasmussen from 1921 to 1924 in an area of the Canadian Arctic extending north to Bylot Island and Admiralty Inlet, south to Baker Lake and Eskimo Point, west to King William Island, and east to Southampton Island. A total of 71 species and subspecies are listed. In addition to the specimens collected, Hørring includes abbreviated field notes from the various areas.

The importance of this work lies primarily in the distributional information it contains; this was particularly important at the time since little was known of bird distribution in the Canadian Arctic. The work provides interesting and significant observations of the distribution of birds in Eclipse Sound and Admiralty Inlet. Unlike most studies of arctic birds, the 5th Thule Expedition extended over four winters, thus providing information on bird distribution during the entire year.

Since the expedition was largely exploratory in nature, no systematic surveys of birds were conducted. However statements on the abundance of birds in certain areas are provided. The expedition appears to have been completed by dog team in winter and by boat and on foot in summer. Information on pelagic species is meagre except where gathered near colonies or along ice-edges.

Hørring gives the first reference to the large Northern Fulmar colony between Baillarge Bay and Elwin Inlet. Much anecdotal information is given about this colony. For example the arrival of fulmars by 23 April 1924 and the observations of thousands flying across the sea ice of Admiralty Inlet between the ice-edge and the breeding cliffs on 2 May 1924 indicate that the species migrates into the area in large numbers relatively early during at least some seasons. Within the Lancaster Sound area, Hørring presents Freuchen's comments on the Oldsquaw, Common Eider, King Eider, Snow Goose, Rock Ptarmigan, Common Loon [possibly confused with Yellow-billed Loon], Red-throated Loon, Semipalmated Plover [not collected; possibly Ringed Plover], Purple Sandpiper, Sanderling, Black-legged Kittiwake, Sabine's Gull, Great Black-backed Gull, Thayer's Gull, Glaucous Gull, Parasitic Jaeger, Long-tailed Jaeger, Black Guillemot, Thick-billed Murre, Raven, Hoary Redpoll, Snow Bunting and Lapland Longspur.

Johnson, S.R., W.E. Renaud, W.J. Richardson, R.A. Davis, C. Holdsworth and P.D. Hollingdale. 1976a. Aerial surveys of birds in eastern Lancaster Sound, 1976 (Vol.1) and Appendix A--Distribution Maps (Vol.2). Unpubl. Rept. by LGL Ltd. to Norlands Petroleum Ltd. 365 p + 307 maps.

Scope and Relevance

This report summarizes the data collected during systematic weekly aerial surveys of birds in eastern Lancaster Sound from 2 May to 28 September 1976. Twenty-three species of marine-associated birds are discussed with regard to spatial and temporal distribution and habitat utilization during the 5-month period.

This is the only systematic aerial survey of birds that has been conducted in Lancaster Sound. All previous studies of bird distribution there had been largely qualitative and opportunistic in their approach. Hence this study provides the best qualitative and quantitative information on the status and distribution of marine birds in the area.

Study Design

This study was specifically designed to inventory the birds of eastern Lancaster Sound and establish patterns of movement and habitat utilization during the May to September season. Weekly aerial surveys were flown at both 200 m and 1200 m from the north and south shores or (when present) ice-edges and along eight north/south lines across Lancaster Sound. With the exception of one incomplete survey, the total length of each weekly survey ranged (depending on lengths of ice-edges) from 1113 to 1498 km. All transects were surveyed from a Twin Otter aircraft by a crew of three observers. The aircraft maintained an altitude of 45-50 m ASL and a ground speed of 160 km/hr.

About 85,000 records were collected; computer processing allowed intensive analysis and detailed mapping of the data. The appendix to the report contains weekly maps of distribution for the major species; summarized maps of distribution are contained in the text. Densities and/or counts are plotted for each 2-min (about 5 km) segments of each transect. Overlays, based on LANDSAT imagery and observations during the surveys, are included for each survey.

The following additional material concerning the above report by Johnson et al. has become available since the first printing of the bibliography.

Within the obvious limitations of aerial survey techniques, this study provides information on distribution and relative abundance of major bird species. The main limitations are in attempts to estimate the total numbers of birds utilizing eastern Lancaster Sound. As stressed in the report, the results of aerial surveys provide indices of abundance rather than absolute numbers. It is well known that aerial surveyors do not detect all birds present along the transect strip; hence the extrapolated numbers of birds using eastern Lancaster Sound shall be regarded as conservative. However, the indices themselves are useful in establishing temporal and spatial distribution and comparing habitat utilization among the areas studied.

Ice conditions were mapped for each weekly survey period using LANDSAT imagery and observations during the surveys.

Ice conditions are summarized here.

During the first two weeks of May, Lancaster Sound was completely ice-covered except for cracks in the offshore pack-ice and the shore leads along the coasts of Devon Island and Baffin and Bylot Islands. The pack-ice began to break-up during the last two weeks of May and total ice-cover was estimated to be less than 50% by mid-June. The drifting pack-ice had almost completely left the study area by late June; thereafter only small amounts of drifting ice (never covering more than 10% of the study area) were recorded.

Land-fast ice broke up gradually and there was much local variation among the various coastlines. In early May, Cape Warrender was the only

coastal area without fast-ice. Little change occurred in the position of the fast-ice edge until June when most coasts became free of fast-ice. Exceptions were Queen Harbour, Navy Board Inlet and Dundas Harbour (where fast-ice persisted until late July); and Croker Bay (where fast-ice persisted until about 10 August). Little refreezing had occurred by late September when the study ended.

Major Findings

To aid in analysis and presentation of results, the study area was arbitrarily divided into six subdivisions (see Figure A). These subdivisions are used for convenience in the following sections. The boundaries between subdivisions are largely arbitrary and without biological significance. References to the 'study area' in this review refer to the area surveyed by Johnson *et al* (see Figure A), not to the whole area of interest to this bibliography.

The principal findings for the common species are summarized here. Several species that were uncommon in eastern Lancaster Sound are not discussed in the following summary. These species include the Common Loon, Yellow-billed Loon, Red-throated Loon, Canada Goose, Brant, Red Phalarope, Pomarine Jaeger, Parasitic Jaeger, Long-tailed Jaeger, Skua, Thayer's Gull, Sabine's Gull and Arctic Tern.

Northern Fulmar

The Northern Fulmar was one of the most common species observed during the study; the maximum counted during a single weekly survey was 62,399 individuals. No Fulmars nest within the study area; the nearest colonies are at Baillarge Bay in Admiralty Inlet, Prince Leopold Island and two colonies on SW Devon Island.

Fulmars were widespread in small numbers in E Lancaster Sound from 2 May into June. A major influx of fulmars was noted in late June when the main concentrations of fulmars occurred along the coasts and landfast

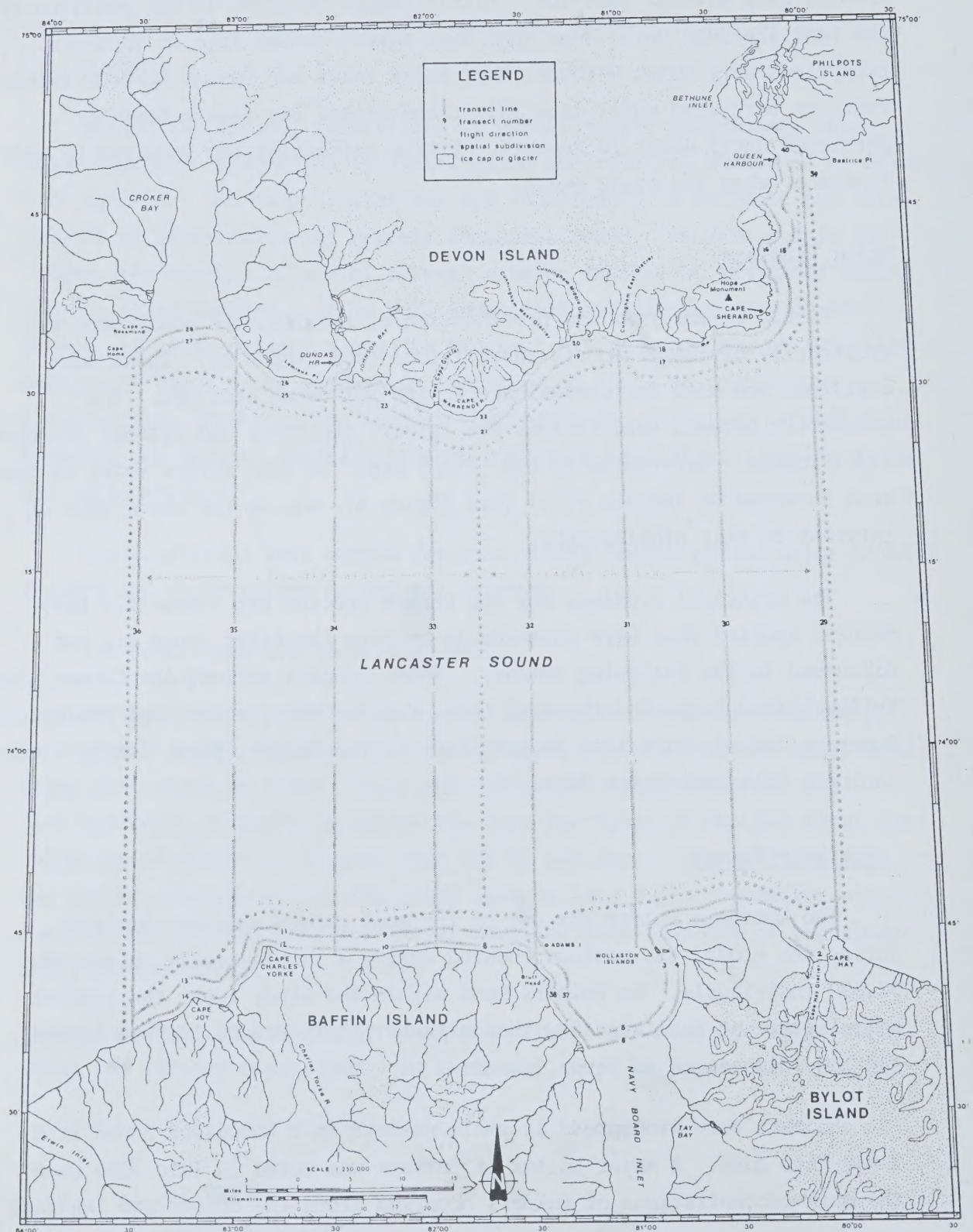


FIGURE A. Map of Study Area Showing Spatial Subdivisions and Positions of Transect Lines, 25 - 26 July 1976.

ice-edges of Bylot and Baffin Islands. Large numbers of fulmars were also present in offshore waters at this time; over 70% of the estimated 65,000 fulmars present on 27-28 June were over 1400 m from shore. Large numbers of fulmars were present in E Lancaster Sound until mid-September when an estimated 87,500 were present. The numbers of fulmars declined steeply after mid-September.

During July, dense concentrations of fulmars were found at the only remaining land-fast ice-edges across Croker Bay and Navy Board Inlet. By late July, as these ice-edges breakup, a major build-up of fulmars began along the coasts and nearshore waters of S Devon Island and the section of SE Devon Island that was W of Cape Sherard. Densities in these areas in August and early September commonly reached 100-300 fulmars/sq km with a maximum of 1357 fulmars/sq km along the coast west of Cape Sherard on 5 September. These concentrations persisted until 12-13 September.

Snow Goose

Snow Geese were recorded from 6 June to 6 September. Few were observed during regular aerial surveys until late July and August (peak of 1,047 individuals on 8-10 August) when family groups with broods and flocks of moulters were observed on lakes and ponds near the coast. Important areas during this period were Croker Bay and Dundas Harbour (moulters only) and the W side of Navy Board Inlet (moulters and family groups.)

Oldsquaw

Small numbers of Oldsquaw were present in May. The main influx of spring migrants began in early June and peaked towards the end of June. The maximum number of Oldsquaws recorded during one weekly survey was 5,709 on 27-28 June, after which numbers decreased steadily during July.

During June and July flocks of up to 500 individuals were recorded along the coasts and ice-edges of the S margin of Lancaster Sound, particularly at Cape Hay and in the shallow waters near the Wollaston Islands,

Adam's Island, and between Cape Charles Yorke and Cape Joy on the N coast of Baffin Island. A few hundred individuals moulted along the glacier fronts between Cape Sherard and Cape Warrender, S Devon Island, during August.

The number of Oldsquaws increased during late August and September (maximum on one survey was 4,637 birds on 26-28 September). In September, the species was concentrated along the E shore of Navy Board Inlet, the SE coast of Devon Island between Bethune Inlet and Cape Sherard, and at Dundas Harbour.

Common Eider and King Eider

The King Eider was the most common duck in E Lancaster Sound in 1976. The Common Eider was moderately common but was less numerous than either the King Eider or the Oldsquaw. Both eider species were present in small numbers when the study began on 2 May. The first main influx of King Eiders occurred in mid-May and large numbers were present until early June. Large numbers of Common Eiders (estimated 6,000) arrived at the end of May. Peak numbers of eiders were seen during the first week of June, when over 20,000 eiders were present in E Lancaster Sound; most of these eiders were probably King Eiders.

During the period from 2 May to 7 June, both species of eiders were found almost exclusively along landfast ice-edges and coasts. King Eiders were found more commonly along the S margin of the study area than along the coast of Devon Island, but large concentrations occurred along the Devon Island coast at Cape Warrender and along the landfast ice-edge W of Cape Sherard; this latter area was the first extensive area of shallow coastal water to become free of fast-ice. During this period, Common Eiders were also concentrated at the latter side. After mid-June, the numbers of both species of eiders in the study area stabilized at an estimated 2,000 birds of each species; an additional 2,000-3,000 unidentified eiders were also present. This pattern continued until mid-July with one exception discussed below.

Several movements of eiders through eastern Lancaster Sound occurred after the spring migration: (1) a small movement of predominantly male King Eiders in early July (probably a pre-moult migration to W Greenland), (2) a smaller movement of male Common Eiders in mid-July, and (3) a major movement of female eiders (over 10,000 birds) eastward along the N coast of Baffin Island in early to mid-August.

Small numbers of eiders moulted in the study area in August and September. The most important area was between Cape Warrender and Cape Sherard along south Devon Island where nearly 1,000 individuals moulted. Broods of eiders were most common along the coast of Devon Island west of Cape Sherard. An estimated 3,500 eiders were still present in E Lancaster Sound on 26-28 September.

Throughout the study, almost all eiders were closely associated with coasts and ice-edges.

Glaucous Gull

Few Glaucous Gulls were present until the last half of May; and numbers remained fairly stable through June. An increase began in early July and the numbers peaked in early September (estimated 2,500 individuals in study area). A decline occurred during the last two weeks of September but substantial numbers were still present when the study terminated on 28 September. An estimated 130 pairs nested in the study area. Throughout most of the study period, most Glaucous Gulls (80-90%) in the study area were within one km of the coast or fast-ice edge. However, during the survey on 5-7 September it was estimated that 35% of the Glaucous Gulls were dispersed on waters over one km from shore.

The coastal waters adjacent to the glaciers east of Cape Warrender, Devon Island, supported the highest densities of Glaucous Gulls (45 gulls per sq km between 25 July and 7 September with a peak density of 71.3 gulls/sq km on 9 August).

Ivory Gull

A total of 257 Ivory Gulls were recorded during the study. The species was first recorded on 16 May; increasing numbers were observed until mid-July when a peak of 31 was seen. Variable numbers (8-27 individuals per survey) occurred in August with a second peak of 23 in late August/early September, after which small numbers (3-18 individuals per survey) were recorded.

The south coast of Devon Island was important to Ivory Gulls during the entire study. The single most important area was the glacier/ocean interface and rocky coastline between Cape Sherard and inner Bethune Inlet; large numbers were observed here from the time the fast-ice left this area until the end of September. Croker Bay was relatively important to Ivory Gulls in late August and early September.

Black-legged Kittiwake

The first large movement of kittiwakes occurred in offshore waters from 24 May to 1 June (presumably en route to Prince Leopold Island). About 80% of the estimated 25,000 kittiwakes were present in offshore areas (over 1400 m from landfast ice-edges and ice-free coasts). The major influx into coastal and nearshore waters adjacent to the Cape Hay colony occurred during the first week in June. On 6-7 June, only 28% of the estimated 25,000 kittiwakes were in offshore waters.

From mid-June to mid-August kittiwakes were most concentrated in coastal and nearshore waters near the Cape Hay colony and along the ice-edge in Navy Board Inlet. In late August as the young fledged, kittiwakes dispersed along coasts and nearshore waters in all parts of E Lancaster Sound. A marked increase in numbers in offshore waters between 5-7 and 12-13 September may have represented the eastward autumn migration of birds from colonies W of the study area. Alternately, it may have been due to the fledging and dispersal of young kittiwakes from Cape Hay. An estimated 45,000 kittiwakes were present on 12-13 September.

Throughout the study, the coastal and nearshore waters adjacent to the Cape Hay colony supported the highest concentrations of kittiwakes (average of 277.5 kittiwakes/sq km over the whole study; the maximum density was 1,641.1 birds/sq km on 9 August). To reduce disturbance to the birds, the waters directly beneath the colony were not surveyed; consequently the numbers recorded on the coastal transect near Cape Hay are undoubtedly underestimates of numbers in the Cape Hay area.

During the period from late August through September, densities averaged from 34 to 44 birds/sq km along the coast of N Baffin, SE Devon and S Devon Islands. Kittiwakes were still common in E Lancaster Sound when the study terminated on 28 September.

Thick-billed Murre

Thick-billed Murres were first recorded on 9-11 May when an estimated 96,000 murres were present in E Lancaster Sound; most (over 90%) were in offshore cracks and leads in the pack-ice. It was thought that many of the murres observed on 9-11 and 16-20 May were moving W to the colony at Prince Leopold Island where, according to Nettleship, a major influx was noted on 22-23 May.

Peak numbers of murres (about 180,000--87% in offshore waters) were estimated to be present on 16-20 May; these figures have not been corrected to account for the proportion of the individuals that are not seen by aerial observers, and do not include murres on the Cape Hay colony *per se*.

The numbers of murres in offshore waters (over 1400 m from shore or fast-ice edge) remained high until late June. However, the densest concentrations of murres occurred in coastal and nearshore waters adjacent to the colony at Cape Hay on NE Bylot Island. The mean density for the 19 surveys of the transect nearest the Cape Hay colony was 177.5/sq km; the highest density was 2,404.9/sq km on 24 May. (To avoid undue disturbance to the birds, the part of the coastal transect immediately adjacent to the colony was not surveyed after the fast-ice had disappeared from this area.) Even

though the densest concentrations occurred in coastal and nearshore waters near the colony, most murres in the study area were present in the large area of offshore waters, where they were more dispersed.

Fewer murres were seen in the western and northern portions of the study area during the late incubation and chick-rearing phases of the nesting cycle; it seemed that most murres were foraging within about 30 km of the colony during this period.

Most murre chicks left the colony in late August and early September when the waters near the Cape Hay colony were virtually abandoned by murres. During late August and the first half of September small numbers of murres (both adults and flightless chicks) were distributed throughout eastern Lancaster Sound. Most murres had left the study area by mid-September.

Dovekie

Dovekies were first recorded on 9-11 May and large numbers were observed on 16-20 and 23-24 May. They were observed in flocks in leads and cracks in the pack-ice and they were found almost exclusively in areas far (over 7 km) from the landfast ice-edge. The extrapolated estimate of the numbers present in eastern Lancaster Sound on 23-24 May was 1,630,000 Dovekies. The Dovekies left eastern Lancaster Sound soon after 24 May; only one Dovekie was recorded during the next survey on 30 May - 1 June.

After 1 June, Dovekies were recorded fairly regularly (but in much smaller numbers) primarily in offshore waters. The maximum extrapolated estimates for the June to September period were about 11,000 Dovekies on 20-21 June and 12-13 September. However, Johnson *et al.* suspected that numbers present in this open-water period were seriously underestimated. Throughout the period, no concentrations in any particular part of the offshore zone were noted.

Black Guillemot

Small numbers of guillemots were present in offshore areas in the eastern part of the study area when the surveys began on 2-3 May.

An influx of guillemots was noted on 9-11 May (estimated 6,000 birds were present) in the cracks and leads in the offshore pack-ice; numbers in the offshore pack-ice remained high for the next two weeks. On 23-24 May, nearly 2,900 guillemots were still present among the offshore pack-ice. On this survey, guillemots began to appear along the landfast ice-edges in substantial numbers. By early June, most guillemots were found along coasts and fast-ice edges and few remained in offshore waters. The decrease in numbers offshore was only partly compensated for by the increase in numbers in coastal areas; the excess birds probably represented migrants that moved westward through E Lancaster Sound during May.

Guillemots concentrated along coasts near nesting colonies at Cape Hay, on W Wollaston Island, W of Cape Joy, at Cape Warrender and at Dundas Harbour until mid-August. In total, only a few hundred pairs of guillemots occurred on the coastal transect W of Cape Hay (average 4.3 guillemots/sq km on 19 surveys); highest density recorded on this transect near Cape Hay was 33.8 guillemots/sq km on 5 June.

Following fledging in late August, guillemots dispersed along other coasts away from colonies and into offshore waters where they were more dispersed and harder to detect. At least 1,000 were estimated to be present in offshore waters on 26-28 September.

Geographic Analysis

The relative importance of the six arbitrary geographic subdivisions of E Lancaster Sound (Figure A) for the major species of birds can be seen in Tables A to F. The most important area in terms of average bird densities was the Bylot Island/Navy Board Inlet area; the coasts of S and SE Devon Island were also important (Table G). The four western cross-sound transects

TABLE A Densities of Major Bird Species in the 'Bylot Island/Navy Board Inlet' Subdivision of Eastern Lancaster Sound During Three-week Intervals, 2 May - 28 September 1976.

Species	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July 10 Aug	16 Aug-17 Sept	12-28 Sept	Overall ^{1,2} Density	Peak Transect Density (Date)
Northern Fulmar	Coast Nearshore	0.0 0.0	17.5 0.1	84.3 7.3	109.4 37.5	31.1 35.2	14.2 8.6	13.0 3.3	35.6 15.5	713.18 (12 June) 159.78 (25 July)
Oldsquaw	Coast Nearshore	0.0 0.0	9.1 0.3	36.2 0.2	0.2 0.2	0.2 0.0	3.2 0.0	29.6 0.0	9.7 0.1	157.07 (21 June) 1.46 (18 July)
Common Eider	Coast Nearshore	0.2 0.0	8.7 0.0	4.9 0.0	3.8 0.0	2.7 0.0	0.5 0.0	0.0 0.0	2.6 0.0	58.76 (6 June) 0.0 -
King Eider	Coast Nearshore	12.2 0.0	26.6 0.3	6.6 0.0	17.6 0.0	4.5 0.0	0.0 0.0	0.2 0.0	8.6 0.0	201.99 (5 July) 1.40 (30 May)
All Eiders ³	Coast Nearshore	12.4 0.0	35.6 0.3	14.9 0.0	30.9 0.0	30.4 0.0	3.3 0.1	6.7 0.0	18.8 0.1	219.91 (5 July) 2.80 (22 August)
Glaucous Gull	Coast Nearshore	0.2 0.0	0.9 0.0	2.2 0.0	5.6 0.0	3.1 0.1	2.3 0.1	2.6 0.3	2.6 0.1	12.82 (12 July) 1.20 (25 July)
Black-legged Kittiwake	Coast Nearshore	0.1 0.0	195.2 40.3	83.0 0.8	152.6 22.3	164.1 8.0	99.5 12.4	87.7 2.3	115.8 11.7	1641.14 (9 August) 123.94 (6 July)
Thick-billed Murre	Coast Nearshore	53.8 0.0	268.3 43.4	47.0 30.1	45.5 12.0	15.6 79.7	7.0 5.5	0.0 0.0	53.1 23.6	2404.91 (24 May) 375.17 (1 August)
Dovekie	Coast Nearshore	13.6 0.0	0.0 0.0	0.0 0.1	0.0 0.0	0.0 0.2	0.0 0.0	0.0 0.0	1.6 0.0	122.44 (20 May) 1.73 (25 July)
Black Guillemot	Coast Nearshore	0.0 0.6	9.3 0.2	1.2 0.0	2.4 0.0	1.6 0.1	0.6 0.1	0.0 0.0	2.0 0.1	33.82 (6 June) 4.20 (16 May)
All Birds ⁴	Coast Nearshore	81.7 0.7	536.3 93.7	269.4 38.9	347.3 72.2	246.9 123.3	130.9 27.0	139.8 6.0	239.8 51.4	2417.34 (24 May) 414.97 (1 August)

¹ Excludes incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

³ Includes Common Eider, King Eider and unidentified eiders.

⁴ Includes the above species plus other less common species plus unidentified birds.

TABLE B Densities of Major Bird Species in the 'North Baffin Island' Subdivision of Eastern Lancaster Sound During Three-week Intervals, 2 May - 28 September 1976.

Species	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July-10 Aug	16 Aug-7 Sept	12-28 Sept	Overall ² Density	Peak Transect Density (Date)
Northern Fulmar	Coast Nearshore	0.3 1.2	12.2 2.3	62.6 4.7	8.3 5.2	14.1 12.2	17.3 11.1	53.4 11.6	22.5 7.7	227.16 (28 June) 63.19 (22 August)
Oldsquaw	Coast Nearshore	0.4 0.0	5.0 0.1	33.5 0.1	17.2 0.3	0.1 0.0	0.3 0.0	12.9 0.0	9.7 0.1	148.60 (21 June) 4.04 (4 July)
Common Eider	Coast Nearshore	0.0 0.0	0.7 0.0	3.1 0.1	9.1 0.1	4.6 0.0	0.0 0.0	0.0 0.0	2.7 0.0	49.85 (19 July) 1.41 (20 June)
King Eider	Coast Nearshore	25.1 0.0	20.4 0.0	11.0 0.0	12.5 0.0	4.2 0.0	0.0 0.0	0.8 0.0	10.9 0.0	258.86 (20 May) 0.31 (4 July)
All Eiders ³	Coast Nearshore	25.1 0.0	21.3 0.0	27.0 0.1	45.2 0.7	14.1 0.9	7.8 0.8	19.9 0.3	23.1 0.4	258.86 (20 May) 11.10 (9 August)
Glaucous Gull	Coast Nearshore	0.1 0.0	0.8 0.1	0.2 0.0	0.3 0.0	1.7 0.0	1.4 0.0	0.9 0.0	0.8 0.0	10.49 (9 August) 0.0
Black-legged Kittiwake	Coast Nearshore	0.0 0.0	1.1 0.1	5.8 0.1	4.8 0.5	4.1 0.9	34.2 0.4	55.4 5.3	13.3 1.0	218.77 (30 August) 33.28 (20 September)
Thick-billed Murre	Coast Nearshore	0.7 0.0	7.0 1.4	8.7 1.4	11.6 0.7	0.0 0.9	0.0 0.1	0.0 0.0	4.2 0.6	133.33 (12 July) 5.74 (20 June)
Dovekie	Coast Nearshore	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.1	0.0 0.0	0.0 0.1	0.0 0.0	0.0 0.34 (13 Sept)
Black Guillemot	Coast Nearshore	0.2 0.1	0.8 0.2	6.0 0.0	0.6 0.1	1.5 0.1	0.2 0.0	0.1 0.0	1.4 0.1	19.42 (21 June) 1.29 (30 May)
All Birds ⁴	Coast Nearshore	26.9 1.4	48.5 4.2	144.6 6.6	88.2 7.4	35.8 15.1	62.0 12.4	142.7 17.5	75.3 9.9	345.56 (28 June) 63.19 (22 August)

¹ Excludes incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

³ Includes Common Eider, King Eider and unidentified eiders.

⁴ Includes the above species plus other less common species plus unidentified birds.

TABLE C Densities of Major Bird Species in the 'Southeast Devon Island' Subdivision of Eastern Lancaster Sound During Three-week Intervals, 2 May - 28 September 1976.

Species	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July-10 Aug	16 Aug-17 Sept	12-28 Sept	Overall ² Density	Peak Transect Density (Date)
Northern Fulmar	Coast Nearshore	9.2 0.1	0.1 0.1	10.3 0.1	10.0 16.4	46.1 78.5	166.8 153.7	4.5 68.8	46.2 53.1	1356.86 (5 September) 531.53 (13 September)
Oldsquaw	Coast Nearshore	0.0 0.0	6.7 0.0	15.6 0.0	4.4 0.0	3.8 0.0	3.7 0.0	7.6 0.0	5.7 0.0	35.93 (5 September)
Common Eider	Coast Nearshore	0.1 0.0	39.6 0.0	15.4 0.4	7.3 0.0	1.2 0.0	0.0 0.0	0.0 0.0	6.8 0.1	132.85 (24 May) 2.07 (13 June)
King Eider	Coast Nearshore	5.4 0.0	86.1 0.2	2.9 0.3	0.0 0.0	0.3 0.0	0.1 0.0	0.0 0.0	9.8 0.1	181.31 (24 May) 1.45 (13 June)
All Eiders ³	Coast Nearshore	5.5 0.0	133.7 12.6	23.8 0.7	10.3 0.0	7.2 0.0	11.0 1.3	6.6 0.0	22.9 1.7	207.84 (6 June) 60.22 (23 May)
Glaucous Gull	Coast Nearshore	0.4 0.0	2.6 0.1	1.2 0.1	3.8 0.1	3.2 0.1	4.5 0.3	2.2 0.1	2.8 0.1	22.04 (5 September) 8.76 (6 September)
Black-legged Kittiwake	Coast Nearshore	0.1 0.0	2.4 0.2	11.2 0.2	8.1 3.1	10.8 1.8	30.2 12.9	46.7 19.3	19.4 6.2	273.74 (5 September) 70.70 (15 September)
Thick-billed Murre	Coast Nearshore	1.2 1.1	10.5 1.1	0.9 0.9	0.9 2.8	0.0 0.1	0.0 0.0	0.1 0.0	1.4 0.7	33.09 (24 May) 7.46 (13 June)
Dovekie	Coast Nearshore	12.9 0.0	0.5 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.1	1.5 0.0	29.83 (11 May) 0.78 (23 May)
Black Guillemot	Coast Nearshore	0.4 0.3	1.4 0.0	0.5 0.0	0.4 0.2	0.1 0.0	0.0 0.0	0.0 0.0	0.3 0.1	5.04 (24 May) 2.53 (16 May)
All Birds ⁴	Coast Nearshore	29.8 1.4	159.3 14.6	66.1 2.2	39.6 22.7	75.8 80.9	222.0 168.5	68.1 88.6	102.8 62.0	1656.45 (5 September) 564.30 (13 September)

¹ Excludes incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

³ Includes Common Eider, King Eider and unidentified eiders.

⁴ Includes the above species plus other less common species plus unidentified birds.

TABLE D Densities of Major Bird Species in the 'South Devon Island' Subdivision of Eastern Lancaster Sound During Three-week Intervals, 2 May - 28 September 1976.

Species	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July-10 Aug	16 Aug-7 Sept	12-28 Sept	Overall ² Density	Peak Transect Density (Date)
Northern Fulmar	Coast Nearshore	21.6 0.1	0.3 0.1	14.2 1.1	7.7 11.4	219.5 58.2	196.7 55.9	25.1 45.1	76.3 24.2	552.97 (9 August) 252.13 (13 September)
Oldsquaw	Coast Nearshore	0.0 0.4	0.5 0.0	0.2 0.0	8.1 0.0	1.0 0.0	7.7 0.0	9.0 0.1	4.1 0.1	42.80 (19 September) 3.11 (16 May)
Common Eider	Coast Nearshore	0.1 0.0	1.7 0.0	1.4 0.0	6.3 0.0	5.2 0.0	0.0 0.0	0.5 0.0	2.2 0.0	34.18 (19 July) 0.28 (25 July)
King Eider	Coast Nearshore	41.6 0.1	7.1 0.0	0.2 0.0	0.5 0.0	3.1 0.0	0.2 0.0	3.1 0.0	6.9 0.0	343.07 (20 May) 0.93 (16 May)
All Eiders ³	Coast Nearshore	42.0 0.1	8.8 0.0	1.8 0.0	10.6 0.0	9.9 0.0	21.4 0.3	12.1 0.0	14.9 0.1	343.85 (20 May) 2.83 (17 August)
Glaucous Gull	Coast Nearshore	0.3 0.0	0.7 0.0	0.2 0.0	7.3 0.0	13.6 0.6	17.9 1.4	7.2 0.0	7.5 0.3	71.53 (9 August) 8.76 (6 September)
Black-legged Kittiwake	Coast Nearshore	0.0 0.0	0.8 0.4	4.9 0.6	13.9 3.6	3.4 0.5	51.2 2.8	8.4 14.9	13.1 3.2	318.26 (5 September) 76.42 (27 September)
Thick-billed Murre	Coast Nearshore	4.0 1.2	5.8 1.9	8.0 0.9	2.8 1.7	0.0 0.6	0.0 0.0	0.0 0.0	2.6 0.9	38.69 (15 June) 10.88 (16 May)
Dovekie	Coast Nearshore	0.2 0.0	0.0 0.2	0.0 0.5	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.0	0.1 0.1	1.55 (20 May) 3.50 (20 June)
Black Guillemot	Coast Nearshore	0.4 0.4	2.0 0.0	4.8 0.0	2.0 0.1	3.6 0.1	0.1 0.0	0.0 0.1	1.8 0.1	18.13 (9 August) 2.53 (16 May)
All Birds ⁴	Coast Nearshore	60.8 2.2	18.9 2.6	34.5 3.1	53.6 16.9	247.4 60.0	296.1 60.4	62.2 60.2	120.3 28.8	636.76 (29 August) 266.40 (13 September)

¹ Excludes incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

³ Includes Common Eider, King Eider and unidentified eiders.

⁴ Includes the above species plus other less common species plus unidentified birds.

TABLE E Densities of Major Bird Species in the 'Crocker Bay, Devon Island' Subdivision of Eastern Lancaster Sound During Three-week Intervals, 2 May - 28 September 1976.

Species	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July-10 Aug	16 Aug-7 Sept	12-28 Sept	Overall ² Density	Peak Transect Density (Date)
Northern Fulmar	Coast Nearshore	0.0 0.1	0.4 0.0	26.1 0.9	113.8 5.0	185.9 24.2	75.1 27.7	22.3 4.2	62.8 11.7	774.62 (3 August) 201.99 (9 August)
Oidsquaw	Coast Nearshore	0.0 0.0	0.0 0.0	11.0 0.1	8.7 0.0	2.5 0.0	3.4 0.0	0.7 0.1	3.5 0.0	39.15 (28 June) 0.31 (13 June)
Common Eider	Coast Nearshore	0.0 0.0	0.7 0.0	2.6 0.0	0.3 0.0	0.5 0.0	0.0 0.0	0.0 0.0	0.5 0.0	13.36 (28 June) 0.0
King Eider	Coast Nearshore	0.4 0.0	3.1 0.0	0.1 0.0	0.2 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.0	13.05 (6 June) 0.16 (30 May)
All Eiders ³	Coast Nearshore	0.5 0.0	4.1 0.0	3.4 0.4	10.1 0.0	4.2 0.1	3.4 0.3	1.0 0.0	3.6 0.1	62.50 (5 July) 2.50 (17 August)
Glaucous Gull	Coast Nearshore	0.2 0.4	0.4 0.0	0.5 0.0	1.8 0.1	1.1 0.4	2.9 0.6	5.4 0.6	2.2 0.3	10.93 (5 September) 2.18 (16 May)
Black-legged Kittiwake	Coast Nearshore	0.0 0.0	0.5 0.1	4.2 0.2	6.8 0.5	0.3 0.6	6.9 0.6	28.1 6.2	8.5 1.6	74.58 (26 September) 13.87 (27 September)
Thick-billed Murre	Coast Nearshore	1.4 3.5	9.5 1.7	15.8 0.7	2.7 0.7	0.1 0.4	0.0 0.0	0.0 0.0	3.4 0.7	51.53 (21 June) 14.92 (16 May)
Dovekie	Coast Nearshore	0.0 0.0	0.0 0.0	0.0 0.4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 2.18 (20 June)
Black Guillemot	Coast Nearshore	0.1 0.1	3.7 0.0	6.9 0.4	1.6 0.2	1.1 0.4	0.1 0.0	0.0 0.1	1.6 0.1	22.01 (21 June) 2.85 (9 August)
All Birds ⁴	Coast Nearshore	2.1 4.0	18.6 1.9	68.5 3.2	146.6 6.6	200.1 26.1	92.9 29.5	58.3 11.2	86.8 14.7	783.94 (3 August) 201.99 (9 August)

¹ Excludes incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

³ Includes Common Eider, King Eider and unidentified eiders.

⁴ Includes the above species plus other less common species plus unidentified birds.

TABLE 1
DENSITIES OF MAJOR BIRD SPECIES ON "CROSS-SOUND" TRANSECTS IN EASTERN LANCASTER SOUND
During Three-week Intervals, 2 May - 28 September 1976.

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Species	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July-10 Aug	16 Aug ¹ 7 Sept	12-28 Sept	Overall ² Density	Peak Transect Density (Date)
Northern Fulmar	Eastern Western	0.4 0.5	0.6 0.3	10.8 5.8	3.0 6.5	6.3 6.7	10.1 3.2	7.1 2.3	5.3 3.6	29.88 (27 June) 25.25 (25 July)
Oldsquaw	Eastern Western	0.0 0.0	0.1 0.0	0.0 0.2	0.2 0.0	0.0 0.0	0.0 0.0	0.1 0.1	0.1 0.0	2.87 (4 July) 1.11 (21 June)
Common Eider	Eastern Western	0.0 0.0	0.0 0.0	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.61 (21 June) 0.07 (18 July)
King Eider	Eastern Western	0.1 0.0	0.1 0.1	0.2 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.0	2.42 (19 July) 0.73 (18 July)
All Eiders ³	Eastern Western	0.1 0.2	0.2 0.2	0.5 0.2	0.4 0.6	0.0 0.0	0.0 0.0	0.2 0.1	0.2 0.2	2.42 (19 July) 1.61 (13 July)
Glaucous Gull	Eastern Western	0.0 0.0	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.3	0.1 0.1	0.2 0.0	0.1 0.1	1.51 (19 September) 2.91 (9 August)
Black-legged Kittiwake	Eastern Western	0.0 0.0	0.6 0.6	5.4 0.5	1.9 0.3	1.2 0.1	2.4 0.4	5.1 2.3	2.3 0.6	54.63 (27 June) 9.68 (13 September)
Thick-billed Murre	Eastern Western	4.9 6.6	11.3 5.2	5.3 2.5	3.2 0.9	4.7 0.5	1.6 0.4	0.1 0.3	4.4 2.3	33.01 (24 May) 22.64 (10 May)
Dovekie	Eastern Western	65.8 1.9	74.2 4.5	0.3 0.4	0.2 0.2	0.0 0.0	0.1 0.1	0.2 0.3	20.4 1.1	754.83 (23 May) 39.03 (25 May)
Black Guillemot	Eastern Western	0.2 0.4	0.2 0.1	0.0 0.1	0.0 0.0	0.0 0.1	0.0 0.0	0.0 0.1	0.1 0.1	1.27 (23 May) 2.03 (10 May)
All Birds ⁴	Eastern Western	73.7 9.6	87.2 11.1	22.7 9.9	9.1 8.6	12.3 7.6	14.2 4.3	13.1 5.6	33.3 8.0	763.09 (23 May) 49.67 (25 May)

¹ Excludes incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

³ Includes Common Eider, King Eider and unidentified eiders.

⁴ Includes the above species plus other less common species plus unidentified birds.

TABLE G Densities of Birds (all species combined) in the Various Subdivisions of Eastern Lancaster Sound During Three-week Intervals, 2 May - 28 September 1976.

Subdivision	Transect Location	2-20 May	23 May-7 June	13-28 June	4-19 July	25 July-10 Aug	16 Aug-7 Sept	12-28 Sept	Overall ² Density	Peak Single Transect Density (Date)
Bylot Island/ Navy Board Inlet	Coast Nearshore	81.7 0.7	536.3 93.7	269.4 38.9	347.3 72.2	246.9 123.3	130.9 27.0	139.8 6.0	239.8 51.4	2417.34 (24 May) 414.97 (1 August)
North Baffin Island	Coast Nearshore	26.9 1.4	48.5 4.2	144.6 6.6	88.2 7.4	35.8 15.1	62.0 12.4	142.7 17.5	75.3 9.9	345.56 (28 June) 63.19 (22 August)
Southeast Devon Island	Coast Nearshore	29.8 1.4	159.3 14.6	66.1 2.2	39.6 22.7	75.8 80.9	222.0 168.5	68.1 88.6	102.8 62.0	1656.45 (5 September) 564.30 (13 September)
South Devon Island	Coast Nearshore	60.8 2.2	18.9 2.6	34.5 3.1	53.6 16.9	247.4 60.0	296.1 60.4	62.2 60.2	120.3 28.8	636.76 (29 August) 266.40 (13 September)
Croker Bay	Coast Nearshore	2.1 4.0	18.6 1.9	68.5 3.2	146.6 6.6	200.1 26.1	92.9 29.5	58.3 11.2	86.8 14.7	783.94 (3 August) 201.99 (9 August)
Cross-Sound	Eastern Western	73.7 9.6	87.2 11.1	22.7 9.9	9.1 8.6	12.3 7.6	14.2 4.3	13.1 5.6	33.3 8.0	763.09 (23 May) 49.67 (23 May)

¹ Excluding incomplete survey on 22 August.

² Includes incomplete survey on 22 August.

had the lowest overall density (8.0/sq km). The densities in all offshore areas were generally low (with the exception of Dovekies during May) but because of the large area of offshore waters (greater than 7 km offshore) significant numbers of birds occurred in such areas (Table H).

TABLE H. Extrapolated Peak Numbers of Birds in Offshore Waters
(over 7 km from shore) (from Johnson *et al* - 1976a)

Species	May	June	July	August	September
Northern Fulmar	9,100	39,000	57,200	21,100	29,600
Black-legged Kittiwake	13,000	7,600	6,200	6,200	15,500
Thick-billed Murre	136,600	108,200	27,800	13,300	3,900
Dovekie	1,629,500	10,100	6,300	1,700	11,100
Black Guillemot	6,000	500	200	200	1,000

- Kemper, B. 1976. Sea birds and related species of the Admiralty Inlet Area. pp. 63 to 86. In: B. Kemper (ed.) Environmental baseline studies--1975. Strathcona Sound program. Preliminary Report. 1976. Canadian Wildlife Service, Unpubl. Report. 119 pp.

In this report, Kemper describes the distribution of Northern Fulmars, Black-legged Kittiwakes, Greater Snow Geese, Arctic Terns and sea ducks in Admiralty Inlet, Navy Board Inlet and the intervening coast of southern Lancaster Sound during July and August 1975. Brief comments on Thick-billed Murres and Thayer's Gulls are also given. The program was part of an environmental impact study to determine the potential direct and indirect effects of developing the Nanisivik lead-zinc mine at Strathcona Sound. An important aspect of the study was the collection of bird specimens (eggs and young) from major colonies in the area; these were used for chemical, food and parasite analyses, but these results were not included in this report and have not yet been published.

[This report is useful in documenting seabird distribution in the area during a year of early ice break-up. It is also the only extensive aerial survey study of birds to be conducted in Admiralty Inlet. As such it complements the more detailed surveys conducted in Lancaster Sound in 1976 (Johnson *et al.* 1976a). However, caution should be exercised in comparing results obtained from the two studies because of the different years and the different census techniques employed (including use of a Bell 206 by Kemper and a Twin Otter by Johnson *et al.*). The report presents very little information on the specific areas surveyed or the methods used to determine the densities of seabirds on cross-sound or shoreline surveys. Thus, it is not possible to evaluate the relative importance to birds of the various areas of Admiralty Inlet and vicinity. Presumably this information will be presented in the final draft of the report to be "published in the winter of 1976-77".]

Major Findings

Northern Fulmars were widely distributed in the areas surveyed, but were concentrated near the colony at Baillarge Bay. Concentrations of

feeding fulmars were reported at several locations in and near Admiralty Inlet, with groups of 1000 or more as far south as Strathcona Sound and 525 in Adams Sound but few further south.

The method used to estimate the size of the Baillarge Bay fulmar colony is of very doubtful accuracy. The estimate is based on the count of incubating fulmars on the main ledge in the centre of the colony where there were about 1000 nests per 100 linear feet of colony. Extrapolating this to the length of the colony, Kemper arrives at a figure of 500,000 pairs. [If this estimate is accurate, it would represent the largest Northern Fulmar colony in the world. Brown *et al.* (1975) estimated the size at only 25,000 pairs. An estimate of population size based on bird density in the centre of the colony is likely to result in serious overestimation of numbers. Given the importance of this colony to the Northern Fulmar population of the eastern Arctic, it is unfortunate that more careful consideration was not given to a detailed study of the distribution and size of the colony.]

A significant finding was the size of the population of Snow Geese present in the study area; a total of 7186 individuals were counted with 1523 (21.2%) being young-of-the-year. Concentrations occurred at several locations adjacent to Admiralty Inlet and Navy Board Inlet, but few were seen along the south shore of Lancaster Sound.

The discussion of seaduck distribution is very brief; with few exceptions no attempt is made on the distribution map to differentiate Oldsquaws from Common Eiders. The map entitled 'SEABIRD DISTRIBUTION (Common Eider, Oldsquaw)' apparently includes King Eiders.

Many Black-legged Kittiwakes were seen at the north end of Navy Board Inlet near the Cape Hay colony, but none were seen during surveys in Admiralty Inlet. A colony of 37 pairs of Thayer's Gulls was found in Strathcona Sound west of the Nanisivik mine site. [B.C. Research (1975) reported several additional gull colonies in the Admiralty Inlet area.]

- Lemieux, L. 1959. The breeding biology of the Greater Snow Goose on Bylot Island, Northwest Territories. *Can. Field-Naturalist* 73:117-128.

Lemieux describes and discusses various aspects of the breeding biology of the Greater Snow Goose based on field observations on southwestern Bylot Island from June to August 1957. It was estimated that 7,500 pairs of Snow Geese nested on Bylot Island; the site was said to be the largest concentration of Greater Snow Geese known. [No larger concentrations have since been located.]

- MacDonald, S.D. and A.H. Macpherson. 1962. Breeding places of the Ivory Gull in arctic Canada. *Nat. Mus. Can., Bull.* 183:111-117.

All historic and recent breeding records of the Ivory Gull in Canada are reviewed. Prior to 1962 only four adequately documented breeding localities are recognized: Prince Patrick Island (in 1853), Polynia Island (in 1853), Meighen Island (in 1916) and a floating ice island last recorded at 79°13.2'N and 97°29.1'W, north of Amund Ringnes Island, in 1960. It is also suggested that there is plausible evidence (from at least three sources) that a colony exists on the Brodeur Peninsula, northwest of Baffin Island.

[Since 1962 only one colony has been found; it is estimated to contain 150 pairs and is located on Seymour Island, N of Bathurst Island (Nettleship and Smith 1975). Recent evidence strongly suggests that the Seymour Island colony may not be the only active colony in the Canadian Arctic (Alliston *et al.* 1976; Finley and Johnston 1977).]

- Nettleship, D.N. 1973. Canadian seabird research. *Marine Pollution Bull.* 4:62-64.

This paper presents a resumé of current research on the status and biology of Canadian seabirds. It is emphasized that 'it is essential that

existing information on seabird colonies be collated, and a monitoring system sufficiently sensitive to detect real population changes in bird numbers, both at sea and at breeding colonies, be developed to establish a baseline from which to measure changes in seabird populations in the future.' The paper includes maps of known colonies in the eastern Arctic; [these colonies have been included in a more up-to-date and complete account by Brown *et al.* (1975).]

● Nettleship, D.N. 1974a. Seabird colonies and distributions around Devon Island and vicinity. Arctic 27:95-103.

Nettleship describes the distribution of seabirds along the entire coast of Devon Island as determined from a flight over the area in an Otter aircraft on 1-2 August 1972, and several shorter flights in the same area from 28 July to 3 August 1972. This paper presents the most complete information available on the locations and sizes of colonies on Devon Island; additional information is also given about seabird colonies on adjacent Cornwallis, Baillie-Hamilton, Dundas and Margaret Islands.

The report is the result of searching the coasts of Devon and adjacent islands for seabird colonies; all potentially-suitable habitat was surveyed and several passes were made along colonies to determine size and composition. This method is useful in determining the order of magnitude of colony size.

Major Findings

Twenty-four active colonies of nesting seabirds were found along the coast of Devon Island; only two of these had been previously described. Fourteen of the 24 colonies were along the S coast of Devon Island. The gull colonies on Devon Island included a total of 355 pairs of Glaucous Gulls and 53 pairs of Thayer's Gulls; 314 Glaucous and 50 Thayer's Gull pairs were along the S coast of the Island. Two Northern Fulmar colonies

were located along the S coast; one at Hobhouse Inlet contained 10,001 to 100,000 pairs, and another at Cape Liddon contained 1,001 to 10,000 pairs. [These fulmar colonies have been more fully documented by Nettleship (1974b), and estimates of numbers refined by Nettleship and Gaston (1977).]

The gull colonies along the east coast of Cornwallis Island facing Wellington Channel included 85 pairs of Glaucous Gulls, 10 pairs of Thayer's Gulls and 125 pairs of Black-legged Kittiwakes. [This kittiwake colony, which was at Separation Point, was not occupied during 1974 or 1975--Davis *et al.* 1974; Alliston *et al.* 1976].

The waters along the south coast of Devon Island from Cape Sherard to Croker Bay were important for feeding fulmars; an estimated 100,000 fulmars were seen in this area. Nettleship stresses that it is likely that four of the six major fulmar colonies known in the Canadian Arctic use the waters of Lancaster Sound for feeding. Nettleship assumes that the high numbers of fulmars in this area are a reflection of high marine productivity. He suggests (by citing Apollonio 1973) that converging currents and run-off from glaciers cause this productivity. [Apollonio (1973) provides no evidence, and in fact does not even suggest, that productivity in this area is a result of up-welling. On the basis of measurements taken in a fiord in Jones Sound where a glacier entered, he states that nutrient concentrations are higher where glaciers enter the sea.]

- Nettleship, D.N. 1974b. Northern Fulmar colonies on the south coast of Devon Island, N.W.T., Canada. *Auk* 91:412.

This brief note reports two previously unreported Northern Fulmar colonies on the south coast of Devon Island. A colony between Stratton Inlet and Hobhouse Inlet contained at least 10,000 to 100,000 breeding pairs; it was suggested that this may be the largest fulmar colony known. Another colony at Cape Liddon contained 1,000 to 10,000 breeding pairs. [The most recent estimates of the size of these colonies are found in Nettleship and Gaston (1977).]

Nettleship, D.N. 1976. Studies of seabirds at Prince Leopold Island and vicinity, Northwest Territories. Preliminary report of biological investigation. Studies on northern seabirds program, Canadian Wildlife Services, Rept. No. 40. (Unpubl.) 24 pp.

This report presents provisional findings of the first season of intensive seabird studies on Prince Leopold Island from May to September 1975. Status, habitat utilization, breeding phenology, breeding performance and diet were studied for Northern Fulmar, Glaucous Gull, Black-legged Kittiwake, Thick-billed Murre and Black Guillemot with emphasis on fulmars and murre. These important studies continued in 1976 and will be completed in 1977. When completed and reported these studies will be major contributions to knowledge of the reproductive and community ecology of arctic seabirds.

Major Findings

Information on numbers and distribution of major species at and near the colony is presented. However, this progress report has been superseded by Nettleship and Gaston (1977) and the reader is referred to the annotation of that report.

Individuals of all five species were present at the colony when the study began on 18 May 1975, although fulmars were thought to have arrived in late April. Egg-laying by fulmars occurred between 4 and 17 June and fledging occurred between 9 and 24 September; 48.5% of the nesting pairs produced fledged young. Murre laid eggs between 20 June and 16 July and fledging occurred between 12 August and 3 September; 80% of the nesting pairs produced a fledged young.

The food analysis was still incomplete at the time the report was written. Amphipods and copepods were present in regurgitations from fulmars during the entire breeding season. Fish were present from the time the young hatched (late July) until mid-September when crustaceans once again predominated.

All murre stomachs examined prior to egg-laying were empty. During egg-laying and incubation, fish predominated in the diet but about 30% of the stomachs also contained amphipods and copepods. The young murre were fed almost entirely on fish (Arctic Cod and sculpin).

● Nettleship, D.N. and A.J. Gaston. 1977. Identity, abundance and patterns of distribution of populations of seabirds in Western Lancaster Sound and Barrow Strait, Northwest Territories. Studies on northern seabirds program, Canadian Wildlife Service, Rept. No. 50. (Unpubl. final Rept. to Arctic Islands Pipeline Program).

This paper discusses the distribution, habitat utilization and foraging range of the Northern Fulmar, Black-legged Kittiwake, Thick-billed Murre and Black Guillemot in East Barrow Strait, W Lancaster Sound, N Prince Regent Inlet and S Wellington Channel during the summer of 1976. It is based on three sources of information:

1. five fixed-wing aerial surveys (Twin-Otter) between
2 August to 12 September.
2. observations of seabirds at Prince Leopold Island, and
3. ship-board observations of seabirds by R.G.B. Brown.

Methods

Aerial survey procedures were similar to those described by Johnson *et al.* (1976a) except that surveys were flown at an altitude of 30.5 m and at a distance of 1000 m from coasts and 200 m from ice-edges (Johnson *et al.* flew surveys at 45 m altitude and at both 200 m and 1200 m from coasts and ice-edges). Correction factors for differences in detectability between front and rear seats were taken from Johnson *et al.* because Nettleship and Gaston's sample size was too small.

Few details are given regarding the nature of the data collected from the ship or at Prince Leopold Island. The seawatches from the ship presumably followed the standardized procedures described in Brown *et al.* (1975).

In most cases, Nettleship presents aerial survey information in terms of number of individuals per two-minute segment of survey. Hence these numbers are directly comparable with data collected simultaneously in eastern Lancaster Sound by Johnson *et al.* (1976a) but cannot be directly compared with those reported by Davis *et al.* (1974) and Alliston *et al.* (1976), who did surveys in East Barrow Strait and adjacent areas in 1974 and 1975 but presented their results in terms of densities on longer transects.

Major Findings

Northern Fulmar

The three fulmar colonies in Nettleship and Gaston's study area are estimated to contain 70,000 nesting pairs: 30,000 pairs at Prince Leopold Island (from unpubl. data), about 5,000 pairs at Cape Liddon (from unpubl. data) and about 35,000 pairs at Hobhouse Inlet (from unpubl. data). [The estimates for all three colonies are considerably lower than estimates previously published in Brown *et al.* 1975.] The Northern Fulmar was the most commonly observed bird in the study area.

Areas of high fulmar concentrations during one or more of the five surveys were:

1. SW Devon Island from approximately Cape McBain to Hobhouse Inlet
2. NW Brodeur Peninsula on Baffin Island from 20 to 70 km NE of Jackson Inlet

3. A 40-km section of coastline extending from 10 km W to 30 km E of Cunningham Inlet on Somerset Island
4. A 20-km section of coastline immediately E of Garnier Bay, Somerset Island

It is estimated that the total number of fulmars (including non-breeders) attending the three colonies in the area is 230,000 birds; it is assumed that half of the fulmars from the Hobhouse Inlet colony may forage in Nettleship and Gaston's study area. Based on 52% nest attendance by breeding adults, it is estimated that 85,000 fulmars should be at sea in early August. Total estimates for numbers at sea within the study area on 2 and 6 August (based on corrected densities from aerial surveys) were 58,840 and 62,347, respectively.

It is suggested that as young fledge and attendance at the breeding colonies declines through September, many fulmars may leave the study area.

Black-legged Kittiwake

The colony at Prince Leopold Island is the only colony located in the study area; it is estimated to contain 29,000 breeding pairs. Other colonies just outside the study area are known at Browne Island (1000 pairs) and Separation Point, Cornwallis Island (125 pairs). [The latter location was not used by kittiwakes in 1974 or 1975 and there is no mention of the kittiwake colony on Somerset Island S of Batty Bay, which is estimated to contain 2000 pairs (Alliston *et al.* 1976).]

Kittiwakes were more locally distributed than were fulmars. During the chick-rearing period in early August most kittiwakes were foraging within 48 km of the colony at Prince Leopold Island. Most of these birds were along the N coast of Somerset Island (concentrations E of Garnier Bay and at Cape Clarence). By late August and early September, kittiwakes were more widespread in both coastal and offshore waters and concentrations

occurred along the south coast of Devon Island (in Radstock Bay, E of Maxwell Bay and near Blanley Bay). Corrected estimates of the total numbers at sea in the study area varied considerably from 3679 on 6 August to 44,036 on 2 August. It is suggested that during August the species is too patchy in distribution to permit effective extrapolations of aerial survey densities to estimates of the total population. The estimates of about 10,000 to 30,000 in the study area during September may be more reliable because the young-of-the-year had fledged and kittiwakes were more widely dispersed.

Thick-billed Murre

One colony, estimated to contain about 70,000 pairs, is located in the study area on Prince Leopold Island. Observations from the colony revealed that a significant portion of the murres were feeding W and SW of Prince Leopold Island until early August; then they fed primarily to the N and NE. Concentrations of murres on the water during one or more of the surveys were noted E of Garnier Bay, S of Prince Leopold Island, at various locations along the SW coast of Devon Island from Beechey Island to Maxwell Bay and in offshore Lancaster Sound from 5 to 35 km SE of Maxwell Bay. A maximum foraging range of 112 km is estimated for murres at the Prince Leopold Island colony in 1976. The highest corrected estimates of the total population at sea were obtained during early August: 21,536 on 2 August and 41,541 on 6 August. It is estimated that about 70,000 murres would be in the study area away from the colony at this time; hence the estimates derived from aerial surveys are lower than expected. In late August and September few murres were recorded.

Black Guillemot

There is no accurate estimate of the number of Black Guillemots nesting in the area. At least 2000 pairs are believed to nest on Prince Leopold Island. Corrected aerial survey estimates indicate that at least 10,000 to 12,000 were present at sea during early August. The three later surveys revealed 6063 on 29 August, 50 on 11 September and 234 on 12 September. Black Guillemots were commonly recorded in coastal waters of SW Devon Island east to Maxwell Bay and along the N and NE coasts of Somerset Island.

Summary

The distribution of all seabirds in the study area was highly non-random; there was a significant tendency for all species to be more concentrated in coastal areas. However, for all four species greater total numbers were estimated to be present in offshore areas as opposed to coastal areas during at least one of the five surveys.

The largest concentrations of seabirds were consistently associated with the mouths of inlets or bays where there was a fast-ice edge or where a river flowed into the sea. The most important of these areas were on SW Devon Island (Maxwell and Radstock Bays) and N Somerset Island (Cunningham Inlet and Garnier Bay). [The relationship between seabird concentrations and freshwater inflow is not entirely obvious from the distribution maps presented. There is also no evidence to support the suggestion that these concentrations are brought about by the availability of spawning Arctic Cod. In fact, Arctic Cod are not known to spawn in the summer.]

An important finding of this study was that major shifts in the foraging ranges of seabirds at Prince Leopold Island occur during August and September and some of these shifts can occur quite rapidly in response to ice and perhaps other unknown environmental factors.

● Salomonsen, F. 1968. The moult migration. *Wildfowl* 19:5-24.

This paper describes aspects of the migration of species of waterfowl to moulting areas. The information about eiders, particularly the King Eider, is relevant to this bibliography.

Most male King Eiders in the eastern and central Canadian Arctic (west to Victoria Island) and N Greenland congregate to moult along coastal W Greenland between Upernavik District and Egedesminde District in summer. The males leave the brooding females and begin arriving at the moulting areas in early July. Immatures may move directly from the wintering areas

to the moulting areas or make partial or complete migrations to the breeding areas before returning to moult off W Greenland.

The moult migration of female eiders is later and covers shorter distances. The large numbers observed by Dalgety (1936) near Clyde Inlet were probably about to moult in that area.

Shortt, T.M. and H.S. Peters. 1942. Some recent bird records from Canada's eastern arctic. Can. J. Res. 20:338-348.

This report lists birds observed incidentally to the voyages of the Canadian Government Arctic Patrol vessel R.M.S. 'Nascopie' in the eastern Arctic during July to September in 1938 and 1939. Three ports in the study area were visited each year: Pond Inlet, Arctic Bay and Fort Ross. The list includes 82 species of birds.

Major Findings

The Oldsquaw was the most common duck at the three ports in the study area in 1938; flocks of 20 to 100 individuals were seen at each port. A flock of 70 was seen at the mouth of the Salmon River in Eclipse Sound in the first week of September 1939.

Common Eiders were reportedly the second most common duck with three flocks totalling 150 at Clyde River on 5-6 September 1938. The writers apparently did not observe the King Eider anywhere in the Lancaster Sound area. [There seems to be some confusion as to the relative numbers of the Common and King Eider in this area. All other sources have listed the King Eider as the commonest of the two eider species in the E Canadian High Arctic (Hørring 1937; Ellis 1956; Davis *et al.* 1976; Johnson *et al.* 1976a). However, there may be some yearly variation in the relative numbers of the two species during spring migration in a given area (e.g., Barrow Strait and adjacent areas in 1974 and 1975--Alliston *et al.* 1976). Eiders observed in late summer and early fall in the

eastern Arctic are almost invariably females or immatures which are difficult to identify to species except under ideal conditions. Hence, the relative numbers of Common and King Eiders present in an area are difficult to determine. In view of the consistently larger numbers of King Eiders observed during spring migration in all major studies of eastern arctic birds, it seems likely that Shortt and Peters were observing mostly King Eiders.]

Thick-billed Murres that were unable to fly were seen in Prince Regent Inlet (exact location not specified) on 27 August 1938; 'some of these were young, others may have been adults in eclipse plumage.'

The most significant observations were of Dovekies [which have recently been found to occur in eastern Lancaster Sound in very large numbers during May and lesser numbers throughout the summer (Johnson *et al.* 1976a).]

'1938: Abundant in Davis Strait and Baffin Bay during the latter part of August. Observed as far west as Lancaster Sound, about 87° west longitude. 1939: First seen in Baffin Bay, east of Devon Island, on August 21; common in Prince Regent Inlet on August 31; some seen in Lancaster Sound and Admiralty. Flocks of 20 to 40 seen in Davis Strait near Clyde River but none seen south of Clyde.'

Shortt and Peters also noted that the Black Guillemot 'was reported to winter at the floe-edge in Admiralty Inlet and at Pond Inlet.'

- Snyder, L.L. 1957. Arctic birds of Canada. Univ. Toronto Press, Toronto. 310 pp.

This is the only book dealing solely with the status and distribution of birds in arctic Canada. It is useful in delimiting the ranges of bird species; however, Godfrey (1966) is a more recent general reference.

● Tuck, L.M. 1960. The murre--their distribution, populations and biology. Canadian Wildlife Service, Monograph No. 1. 260 pp.

This is the most exhaustive monograph available on the genus *Uria*, which includes the Thick-billed Murre and Common Murre. It consists of a detailed review of all existing literature (as of 1960) on the genus, and combines this information with much original research by the author. The Thick-billed Murre colony at Cape Hay, Bylot Island, was one of Tuck's main study areas; reference has been made to this colony throughout the book. A brief description of the colonies at Prince Leopold Island and Cape Graham Moore is also given.

Major Findings

[Colony estimates presented by Tuck have been considerably updated by Brown *et al.* (1975) and are therefore not extensively discussed here. Tuck's estimate of five million Thick-billed Murres for the eastern Canadian Arctic considerably exceeds estimates of the present population (see Brown *et al.* 1975). Possible reasons for a marked decline of numbers in both the Canadian arctic and west Greenland are discussed by Tull *et al.* (1972) and Evans and Waterstan (1976).] Tuck estimates the total world population of murre (including Thick-billed and Common) at 50 to 100 million; the Thick-billed Murre predominates by a factor of 3 : 1. Hence, the world population of Thick-billed Murres may be in the range of 37.5 to 75 million.

Tuck estimated that 400,000 breeding pairs occur at the Cape Hay colony. [More recent surveys by the Canadian Wildlife Service have indicated that the present population is lower (analysis is incomplete and accurate figures are not yet available). Evans and Waterstan (1976) provide good evidence of a drastic decline of Thick-billed Murre populations elsewhere in the eastern Arctic. However, details of Tuck's methods of determining population size at the Cape Hay colony were not published and it is possible that the colony size was initially overestimated in 1957. If Tuck extrapolated known nest densities over a cliff area extending to a height of 1500 feet

(dimensions of the cliff as listed in his book) then overestimates would result since it is now known that the cliffs are a maximum of 700 to 800 feet high. Hence, although there is good evidence that declines are occurring on the wintering grounds, it is unclear to what extent the Cape Hay population has declined since 1957.]

Recoveries of murrelets banded as chicks at Cape Hay indicate that they arrive in Newfoundland waters in early November and winter mainly off the NE and S coasts; large numbers also winter off SW Greenland.

The phenology of events at the Cape Hay colony in 1957 and at Cape Graham Moore in 1954 (where available) are given below:

	<u>Cape Hay</u>	<u>Cape Graham Moore</u>
First egg	20 June	22 June
First hatch	27 July	-
Seagoing	15 August	-

Tuck found that 56% of the first clutches were successfully incubated to hatching and that 30% of the breeding adults laid one replacement clutch, 11% laid two replacement clutches and 3% deserted. Chick losses averaged 11.5%. The population increment at the time of seagoing was 41 chicks/100 pairs. [This value is considerably lower than that recorded by Nettleship at Prince Leopold Island (1976).]

When chicks left the cliffs in mass at Cape Hay, the chicks ranged in age from 18 to 25 days (average, 19 days); when they left the cliffs, they were unable to fly. Each chick was then accompanied out to sea by at least one adult.

With respect to food habits, the Arctic Cod was the most important food item in colder waters throughout the range of the Thick-billed Murre. Arctic Cod represented 90% of the food items brought to the young at Cape Hay in 1957.

The stomachs of adults were not examined. [Bradstreet (1976) and Nettleship (1976) provide more detailed information about the food habits of Thick-billed Murres in Lancaster Sound.]

- Tuck, L.M. and L. Lemieux. 1959. The avifauna of Bylot Island. Dansk Orn. Foren. Tidsskr. 53:137-154.

Tuck and Lemieux present an annotated list of the birds they observed on and from Bylot Island while they were studying the Thick-billed Murre and Greater Snow Goose (respectively) in 1957. They review and include the observations of birds recorded on Bylot Island that had been published elsewhere prior to 1957; 44 species of both certain and hypothetical status are discussed.

Since this list primarily presents incidental observations of birds observed during more detailed studies of Thick-billed Murres and Snow Geese, most species accounts are general and qualitative. However, this paper provides the most complete reference to the birdlife of Bylot Island; only one other reference (Van Tyne and Drury 1959) has reported on the terrestrial birds of Bylot Island. Most other workers who mention Bylot Island as an observation locality have restricted their observations to the waters around the island.

Major Findings

The most important findings are in relation to the two species studied intensively, Snow Geese and Thick-billed Murres. Lemieux estimated that 15,000 Snow Geese nested on Bylot Island in 1957; this is the largest nesting concentration of Greater Snow Geese known. Tuck estimated that 400,000 pairs of Thick-billed Murres and 50,000 pairs of Black-legged Kittiwakes nested on the cliffs west of Cape Hay. Range extensions were given for several species (e.g., Sandhill Crane, Ringed Plover, Sabine's Gull, Horned Lark and Water Pipit).

- Tull, C.E., P. Germain and A.W. May. 1972. Mortality of Thick-billed Murres in West Greenland Salmon Fishery. *Nature* 237:42-44.

This paper documents the seabirds drowned in nets set by a Fisheries Research Board of Canada trawler during salmon-tagging operations off W Greenland in the autumns of 1969, 1970 and 1971. The number of murres caught relative to the number of salmon caught was used as a basis for estimating (from salmon catch statistics) the total number of murres caught by all salmon trawlers fishing in W Greenland waters. Many murres from the Canadian eastern Arctic winter near Greenland and are subject to this type of mortality.

Major Findings

The ratios of murres to salmon caught aboard the research vessel were 0.65 murres per salmon in 1969, 2.32 in 1970 and 1.05 in 1971; the ratio for all three years combined was 1.54. The commercial drift net catch in 1969 was about 353,000 salmon; catches in 1970 and 1971 were similar but precise figures were not available. Using the 1969 drift net catch as a basis, the projected number of murres caught was 230,000 based on the 1969 murre/salmon ratio, 820,000 based on the 1970 ratio and 370,000 based on the 1971 ratio; using the combined data from three years the annual mortality was 540,000 murres. The yearly kill is therefore estimated to be about 500,000 with a margin of error of 50%.

Tuck (1960) estimated that based on the productivity figure of 41 chicks per 100 breeding pairs of murres (derived from his study at Cape Hay, Bylot Island), 1,500,000 chicks left the colonies of the Eastern Canadian Arctic and W Greenland each year. Since an estimated total of 750,000 Thick-billed Murres are hunted annually in Greenland and an estimated 500,000 are killed in salmon drift nets, the two mortalities caused by man approach the yearly number of chicks produced. This does not take into account pre-breeding mortality of young after they leave the nesting cliffs. Other unknown losses occur from oil pollution, natural mortality and hunter kill off Newfoundland.

- Van Tyne, J. and W.H.Drury, Jr. 1959. The birds of southern Bylot Island, 1954. Occasional Papers of the Mus. Zool. Univ. Mich., No. 615:1-37.

This report is an annotated list of birds observed on southern Bylot Island from 12 June to 29 July 1954. Thirty-four species of certain occurrence and 10 additional species of hypothetical occurrence are discussed. Several of the annotations include information supplied by the local Inuit from Pond Inlet.

This report was published at the same time as Tuck and Lemieux (1959); observations made by local Inuit are given in both reports. In general, however, these two lists are complementary. Tuck and Lemieux (1959) concentrated on NW and SW portions of Bylot Island and on studies of seabirds and Greater Snow Geese. van Tyne and Drury were more concerned with shorebirds on the SE shore of the island and the best information on these species, and on most 'terrestrial' passerines, is contained in their paper.

Since Drury established a terrestrial study plot and makes reference to the numbers of pairs of each breeding species that occurred on the plot, information about population density is available. Other details are given regarding numbers of non-breeding species seen; hence some quantitative information about breeding birds in terrestrial areas is presented.

The writers concluded that Bylot Island is on the lower edge of the High Arctic in terms of fauna; northern extensions of certain low arctic species were found. They suggest that the characteristics of the flora support this interpretation.

- Wynne-Edwards, V.C. 1952. Zoology of the Baird expedition (1950). I. The birds observed in central and south-east Baffin Island. Auk 69:353-391.

This paper gives an account of bird observations in the vicinity of Clyde Inlet during a 12-week (19 May to mid-August 1950) field study of plants and freshwater and terrestrial animals (particularly birds). Additional observations are included from a trip to Cape Searle in mid-August. No systematic studies were conducted.

Major Results

The most significant observations concern the first documentation of a major migration route of male King Eiders across the interior of Baffin Island. A heavy migration was first recorded on 19 July (150 to 200 drakes); thereafter the species was recorded almost daily flying eastward down Clyde Inlet. On 21 and 23 July 'flocks totalling many hundreds were seen'. On 4 August numerous flocks, some flying as high as 3000 or 4000 feet, were observed migrating in a northeasterly direction. The migration was also noted at a camp 40 miles SW of the head of Clyde Inlet; there the movement was first noted on 14 July, continued until at least 17 August, and in fine weather included an average of 500 to 1000 observable ducks a 'night'. Large numbers were observed resting on the inlet during this migration; evidently significant numbers stop in the area. Flocks of females or young (numbers inspecified) were observed at the mouth of the inlet on 5 September.

These movements consisted almost entirely of males, probably en route to the Disko Island area of Greenland, which is almost exactly opposite Clyde Inlet. The magnitude of the movement is not specified in terms of absolute numbers but it appears that at least many thousand were observed; probably many more passed unnoticed as there were no systematic migration watches. [These males are now thought to represent breeding adults that have abandoned their incubating mates in the central and eastern Arctic and are proceeding to west Greenland waters to moult (Salomonsen 1968).]

The observations of Dovekies are also of interest. On 5 September 'large numbers...were seen in parties of 5 to 10 as far as the eye can see...immediately outside Clyde Inlet...to the entrance to Pond Inlet.' Unspecified numbers were recorded in Eclipse Sound (7 September), Lancaster Sound (9 September) and southward to Davis Strait (on 10 and 12 September).

No large numbers of Oldsquaw or Common Eiders were observed. The only gull seen in the area was the Glaucous Gull; however, previous records are given for Sabine's Gull and Black-legged Kittiwake. Likewise, Arctic Terns were not observed but previous records exist. No Thick-billed Murres were seen at Clyde Inlet. Unspecified numbers of Black Guillemots were observed in the Clyde Inlet area in July and August.

This reference provides the only records of the Atlantic Puffin for the area; one was seen north of Bylot Island on 9 September 1950, and another was seen off Cape Adaire (about midway between Pond Inlet and Clyde River) on 10 September 1950.

MARINE MAMMALOGY

There are four general reports on the distribution of marine mammals within the study area. R.R.C.S. (1977) and Johnson *et al.* (1976b) studied the marine mammals of E Lancaster Sound (Polar Bears are not included in R.R.C.S. (1977)); and Finley *et al.* (1974) and Finley (1976) report on the marine mammals of Barrow Strait, Wellington Channel and Prince Regent Inlet. Tuck (1957) and Greendale and Brousseau-Greendale (1976) monitored the migration of marine mammals from Cape Hay, Bylot Island.

All other detailed papers have been at the species or group level.

The most complete studies of Polar Bears are Jonkel (1975) and Schweinsburg (1976) for Lancaster Sound and Admiralty Inlet; and Stirling *et al.* (1976) for Barrow Strait, Prince Regent Inlet and Wellington Channel.

Sergeant and Brodie (1975) summarize the abundance and present status of Belugas in Canada with reference to the Lancaster Sound populations; migration phenology and descriptions of concentration areas are best provided by the first four general references mentioned above. General information on biology and movements of Belugas, some of which is based on information from outside the Lancaster Sound study area is presented in Sergeant (1962), Brodie (1971) and Hay and McClung (1974).

Mansfield *et al.* (1975) provide the most recent review of the status of the Narwhal in the eastern Arctic. Only one paper, Mansfield (1971) deals with the present status of the Bowhead Whale in Canadian Arctic waters.

Mansfield (1973) provides the most recent review of the life history, distribution and abundance of the Atlantic Walrus in Canada and Greenland. The best detailed information for this species is presented in the first four references mentioned in this section.

The seals of the Canadian Arctic are treated generally by Dunbar (1949) and Mansfield (1967). The most intensive studies of seals have involved the Ringed Seal. Apart from aerial surveys in 1975 and 1976 (R.R.C.S. 1977) and in 1976 (Johnson *et al.* 1976b), there have been no detailed studies of Ringed Seals in Lancaster Sound. Finley *et al.* (1974), Finley (1976) and Smith *et al.* (1976) provide aerial survey results for Barrow Strait, and parts of Wellington Channel and Prince Regent Inlet; the latter source also provides information on birth lair abundance in Barrow Strait. Several detailed studies of Ringed Seals from outside the area may be of interest to the Lancaster Sound study area (McLaren 1958a, 1958b; Smith 1973a, 1973b, 1975).

Reviews of various aspects of the life histories of other species are provided by Sergeant (1965, 1976) for the Harp Seal, McLaren (1958c) for the Bearded Seal, and Sergeant (1976) for the Hooded Seal. Minimum population estimates of the number of Harp Seals that enter Lancaster Sound are given by Tuck (1957) and Greendale and Brousseau-Greendale (1976).

Information on the diets of pinnipeds is provided by Dunbar (1941c, 1949), Vibe (1950) and Mansfield (1967).

Much important information relating to distribution and behaviour of marine mammals appears in the anecdotal accounts by Degerbøl and Freuchen (1935), in this section, and by Duvall and Handley (1946, 1948), Gunn (1949), and Lawrie (1950) in the section on 'Ornithology and Marine Mammalogy'.

● Banfield, A.W.F. 1974. The mammals of Canada. Univ. of Toronto Press, Toronto. 438 pp.

This book provides the only recent general reference on the mammals of Canada. The depicted ranges of most species of marine mammals within Lancaster Sound and vicinity are not in complete accordance with currently available information:

Beluga. The range should include Prince Regent Inlet, Peel Sound and northern Franklin Strait (cf. Manning and Macpherson 1961; Finley *et al.* 1974; Sergeant and Brodie 1975; Finley 1976; Finley and Johnston 1977).

Narwhal. The range should include N Peel Sound (cf. Manning and Macpherson 1961; Finley *et al.* 1974; Finley and Johnston 1977).

Bowhead Whale. The range should include Barrow Strait, Peel Sound and Prince Regent Inlet (cf. Lubbock 1955; Mansfield 1971; C.W.S. 1972; Finley 1976; Finley and Johnston 1977).

Walrus. The range should include northern McDougall Sound, northern Wellington Channel and Queen's Channel (cf. Mansfield 1967; Finley *et al.* 1974; Finley 1976).

Bearded Seal. The range should include at least E Melville Island (cf. Finley *et al.* 1974; Finley 1976).

Harp Seal. The range should include all of Lancaster Sound, Barrow Strait, Prince Regent Inlet, Bellot Strait, Peel Sound and Admiralty Inlet (cf. Nansen 1924 in Sergeant 1976, Degerbøl and Freuchen 1935; Mansfield 1967; Finley *et al.* 1974; Finley 1976; Finley and Johnston 1977).

● Best, R.C. and H.D. Fisher. 1974. Seasonal breeding of the narwhal (*Monodon monoceros* L.). Can. J. Zool. 52:429-431.

This article discusses the breeding schedule of the Narwhal. It is estimated that the gestation period is 14 months; the reproductive cycle is 2 or 3 years. It is concluded that the Narwhal is a seasonal breeder (in April and May) with birth records occurring in late June, July and August.

● Boreal Institute for Northern Studies. 1975. Canadian arctic renewable resource mapping project. Vol. 2. Inuit Tapirisat of Canada, Renewable Resources Project. 238 pp + map volume.

This volume was intended to generally outline the ranges of the major economically important bird, mammal and fish species that were (or are) utilized by the Inuit in arctic Canada. The maps and written accounts are based on numerous references, the majority of which are summarized in this bibliography. Two references used extensively are C.W.S. (1972) and Banfield (1974). The former is considerably outdated and often based on vague second or third hand information; the latter is very general and contains numerous errors.

The volume contains accounts of waterfowl and seabirds that occur in the Arctic. There are numerous errors in the brief bird accounts. For example Northern Fulmars are (correctly) noted as arriving in the Arctic in April, whereas Thick-billed Murres (which occur within their breeding range over a shorter period than the fulmar) are listed (incorrectly) as being 'found within the Arctic all year round'. MacDonald and Macpherson (1962) are incorrectly referenced as stating that Ivory Gulls 'are thought to nest extensively on floating ice islands'; in fact, they cite one known case of a colony on a floating island of ice.

In summary, this volume is too general and imprecise to be of much use in the Lancaster Sound study area. Numerous recent references provide much more detailed quantitative information.

● Brodie, P.F. 1971. A reconsideration of aspects of growth, reproduction, and behaviour of the White Whale (*Delphinapterus leucas*), with reference to the Cumberland Sound, Baffin Island, population. J. Fish. Res. Bd. Canada. 28:1309-1318.

This is the most important paper on the biology of the Beluga in the eastern Canadian Arctic. Although based entirely on field work outside the present study area (i.e., Cumberland Sound), this report provides information that is of direct relevance to the Lancaster Sound population.

Males are sexually mature at an age of eight years; females at five years. The potential life span is 30 years. The breeding season is in May; gestation lasts 14.5 months and the young are born in late July or early August. Lactation lasts about two years and there is a three-year reproductive cycle.

Degerbøl, M. and P. Freuchen. 1935. Mammals. Rept. Fifth Thule Expedition 1921-1924, Vol. II. No. 4-5. Copenhagen.

This volume consists of a series of accounts of each mammal species recorded in the regions that the expedition visited. During much of this expedition the authors lived with the Inuit during the entire year. The large area traversed by the expedition extended from Ellesmere Island to Hudson Bay, including most of the Lancaster Sound area; much time was spent with the Inuit in the vicinity of Admiralty Inlet and Eclipse Sound.

The authors discuss various aspects of the life history of each species and relate these to the timing and distribution of occurrence in the Canadian Arctic; specific dates and locations of observations are then reported. Few quantitative data are presented, but the behavioural information, which is largely based on anecdotal observations, is remarkably complete and accurate. This work forms the earliest relatively complete picture of marine mammal distribution (especially for the Harp Seal and Narwhal) in the Lancaster Sound district; however, the major topics have been studied and described in more detail by several recent workers (Finley 1976; Johnson *et al.* 1976; R.R.C.S. 1977) and hence are not discussed in detail here.

Major Findings

The Ringed Seal was the most numerous seal in all areas covered by the expedition; areas near Baffin Island supported large concentrations of Ringed Seals.

Freuchen documented large numbers of Harp Seals migrating northward near Button Point, SE Bylot Island. 'They only go into Eclipse Sound on their way north, and often they go rather a long way into Milne Inlet, but turn and go out through Navy Board Inlet.' It was noted that the Harp Seals penetrate into Wellington Channel and Prince Regent Inlet.

There is no reference to the presence of the Bearded Seal in the Lancaster Sound area.

Freuchen notes that Walruses occur at Clyde River, at Scott Inlet between Pond Inlet and Clyde River and in Pond Inlet during a southward migration; haul-out sites occur on three islands off the mouth of Clyde River. The Clyde River area is used as a calving grounds. It is suggested that the Walruses move to Greenland after they leave NE Baffin Island. The spring migration in Lancaster Sound consists of a westward movement of both sexes along the south coast of Devon Island. Walruses occur at Cape Crauford on the W edge of the mouth of Admiralty Inlet¹ but few penetrate very far south into the inlet itself. In 1924, Freuchen noted Walruses at Cape Crauford as early as 30 April and 5 and 12 May. The Inuit at Arctic Bay regarded Cape Crauford as a traditional area for hunting of Walrus.

Freuchen provides valuable information about the early spring occurrence of Narwhals in Lancaster Sound. On 3 April 1924 in Navy Board Inlet he met a group of Inuit who were bringing 203 Narwhal tusks from Admiralty Inlet. During the previous fall animals had been trapped in the ice in Moffet Inlet in southern Admiralty Inlet; there were approximately 600 individuals, at least 400 of which were killed. Freuchen noted that Narwhals were observed at the Admiralty Inlet ice-edge in late April 1924.

The ice hunt for Narwhals at Button Point, Bylot Island, began on 1 July when the ice began to break-up and the first Narwhals were observed. The Inuit claimed that following ice break-up in Eclipse Sound, the Narwhals move north through Navy Board Inlet and do not return until September.

The stomachs of the animals taken by Inuit were found to be largely filled with 'tom-cod' (Arctic Cod).

¹ It is noted in one instance that 'at Cape Crawford (*sic*), on the west side of Admiralty Inlet, there are only bulls.' A contradictory statement appears later in the report: 'At Cape Crauford saw cows only, this always being the case, say the Eskimos.'

Narwhals were reported to occur at Clyde River in spring only when westerly winds produce open water off the coast. The fall migration is more regular.

The Inuit reported to Freuchen that Killer Whales occur regularly in Eclipse Sound and Lancaster Sound, but Freuchen did not see the species.

The presence of Belugas in the Lancaster Sound area is noted briefly: 'In the waters of Baffin Land, they are exceedingly numerous. They occur everywhere on the east and north coasts and move far into Lancaster Sound and adjacent waters.'

Freuchen did not observe Bowhead Whales in Pond Inlet or Lancaster Sound but was told by the Inuit that they occur in the area.

● Dunbar, M.J. 1941c. On the food of seals in the Canadian eastern Arctic. Can. J. Res. 19:150-155.

The stomach contents of 47 Ringed Seals (*Phoca hispida*) from Baffin Island coastal waters (as far north as Clyde River) showed that this species, during the months of August and September at least, depended on planktonic food (mainly the amphipod *Themisto* [*Parathemisto*] *libellula*). The one Harp Seal (*Phoca groenlandica*) examined also contained only planktonic organisms. Five Bearded Seals (*Erignathus barbatus*), which are strictly benthonic feeders, contained decapod crustaceans, a sculpin, and a polychaete.

● Dunbar, M.J. 1949. The Pinnipedia of the arctic and subarctic. Bull. Fish. Res. Bd. Canada. 85:1-22.

Dunbar surveys the existing information on the life histories of the Walrus and the seals in the Arctic and subarctic. While this paper does not present information from the Lancaster Sound area, some information on food habits is of direct interest to this bibliography.

Major Findings

Walrus

Classed as an inshore bottom feeder; various bivalves such as mussels (*Mytilus*, *Modiolus*, *Modiolaria*) and clams (*Mya*, *Cardium* [*Serripes*], *Saxicava*) form the main diet. It is noted that Walruses winter wherever they can find open water.

Ringed Seal

The locality nearest to Lancaster Sound where stomach samples were obtained was Clyde River; there the stomachs obtained were almost empty. Dunbar reports that Ringed Seals are planktonic feeders subsisting on the commoner and larger planktonic crustacea; *Themisto* [*Parathemisto*] *libellula* were very important and *Mysis oculata* was also frequently found in their diet. In the Greenland Sea they were reported (in Gray 1935) to be eating *Themisto* [*Parathemisto*] *libellula* and *Gammarus locusta* and the euphausiid *Meganyctiphanes norvegica*.

Harp Seal

The diet is varied and the species feeds both on the bottom and pelagically. The most detailed observations were from the White Sea where adults during the summer were feeding on planktonic amphipods and euphausiids.

Bearded Seal

Food habits are similar to those of the Walrus; the Bearded Seal is a bottom feeder, eating prawns, bivalve molluscs and benthic fish.

- Ellis, D.V. 1957b. Some observations of mammals in the area between Coppermine and Pond Inlet, N.W.T., during 1954 and 1955. Can. Field-Naturalist 71:1-15.

Ellis provides an annotated list of mammals observed incidentally during an expedition between Coppermine and Pond Inlet from May 1954 to

August 1955. The objective of the expedition was to collect marine samples. Most travelling was done by means of boat and by dogsled over the sea ice.

Ellis provides the first indication of segregation of age (and breeding) classes of Ringed Seals by ice conditions. He found the youngest seals near the floe edges, the medium-sized seals on fast-ice at the mouths of Admiralty Inlet and Pond Inlet, and the oldest and largest seals in the bays and fiords where ice remained the longest. [This segregation has been further documented by McLaren (1958).]

Ellis noted Walruses at the floe edge of Admiralty Inlet and Button Point during April and May 1955. Belugas and Narwhals were first observed at the floe edge in Navy Board Inlet on 24 April 1955.

Brief notes on other species add little to more detailed accounts by other workers.

- Finley, K. 1976. Studies of the status of marine mammals in the central District of Franklin, N.W.T. June-August, 1975. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 183 pp.

This report summarizes the results of studies designed to document the numbers, distribution and movements of marine mammals in the central Canadian Arctic from Melville Island, east to SW Devon Island and south to the base of the Boothia Peninsula. The research in 1975 was designed to provide further information on marine mammals in addition to the data collected incidental to bird surveys in the area in 1974 (Finley *et al.* 1974). This report compares the results of the two years of research.

The 1974 studies indicated that many species of marine mammals were locally distributed in the area; hence, the emphasis in the 1975 study was to use aerial survey techniques to locate concentrations of marine mammals and determine the chronology of their use of these areas. In addition, a more detailed study was made of the Beluga population at Creswell Bay during late July and August 1975.

Major Findings

Polar Bear

An average of 0.008 bears/linear mile was recorded during 8358 linear miles that were flown in offshore and coastal areas in 1975. It should be noted that fixed-wing aerial surveys may not be reliable indicators of the numbers of Polar Bears on fast ice. During late spring, when fast ice covered most of the marine channels, Polar Bears were found to be concentrated in two areas: along the East Barrow ice-edge between NE Somerset Island and Maxwell Bay when this ice-edge was present in June (31% of sightings; 3.8% of survey coverage) and along the SW coast of Devon Island from Beechey Island to east of Maxwell Bay (28% of sightings; 3.5% of area). The maximum concentration noted on a single survey was 15 individuals along 115 miles of coastline between Maxwell Bay and Wellington Channel on 12 June (0.13 bears/linear mile). Surveys were not conducted in Radstock Bay after 12 June; however, Stirling (pers. comm.) reported that 15-20 bears occurred annually in this bay in the summers of 1973 to 1975, and 30-50 bears occur annually in Maxwell Bay (Jonkel 1976).

Polar Bears were also observed to concentrate in areas where polynias occur in the spring such as Penny Strait, Crozier Strait and Bellot Strait.

Ringed Seal

Ringed Seals were widespread and common in the Polar Gas study area. 13,155 observations of Ringed Seals were made during surveys of 7513 square statute miles of fast-ice (1.75 seals/sq mi).¹

Four general areas had high densities of Ringed Seals (>5 individuals/sq mi); two of these were located in or near the areas of concern in this bibliography. These were (1) Aston Bay, NW Somerset Island, (2) NE Prince of Wales Island and Russell Island, (3) east coast of Boothia Peninsula from Lord Mayor Bay to Abernethy Bay and (4) in the vicinity of Bellot Strait. The area where the densities were consistently highest was in

¹ Raw densities uncorrected for observer variability or unseen animals.

Aston Bay (22.3/sq mi in 1974; 25.6/sq mi in 1975). Ringed Seals were relatively evenly distributed in average densities over areas such as Barrow Strait, McDougall Sound and most of the west coast of Somerset Island. These data on densities in various areas were for the June/early July period; due to general ice breakup after this time Ringed Seals became much less detectable and hence detailed analysis was not done.

Although some of the highest densities of seals were recorded in complex coastal areas, the pattern of distribution and abundance was not so clearly defined as to suggest that ice stability (as illustrated by McLaren 1968) was the primary factor involved. Primary productivity, bottom topography, accessibility of food and ice condition which affect birth/lair development are other suggested causes.

Harp Seal

In 1975, Harp Seals were present in the Polar Gas study area from 9 July until surveys ceased on 28 August. Most Harp Seals were observed in the offshore area of East Barrow Strait. A series of 10 transects across East Barrow Strait was flown regularly between mid-July and the end of August. The numbers of Harp Seals in Barrow Strait apparently peaked in late July when it was estimated (based on a density of 0.50 seals/sq mi) that there were at least 2000 Harp Seals present in East Barrow Strait. It was apparent that the large numbers of Harp Seals (136,000+) observed to enter Lancaster Sound (Tuck 1957) did not penetrate as far west as Barrow Strait. The largest herd observed was 519 animals that were hauled-out on pan ice in East Barrow Strait on 21 July 1975.

Harp Seals were usually found in close association with areas of pan ice.

Bearded Seal

The densities of Bearded Seals observed during three survey periods in 1975 are given in Figure a.

Figure a.

Number of Bearded Seals Observed per Linear Mile of Transect Flown during Spring, Early Summer and Late Summer, 1975.

Period	Number of miles surveyed	Number of seals observed	Number of seals per mile
Spring (June 1-24)	8358	38	0.0046
Early Summer (June 25-July 24)	6454	152	0.0236
Late Summer (July 25-August 24)	9350	97	0.0104
Total	24162	287	0.0119

Bearded Seals were found to be locally concentrated. The area of Crozier Strait-McDougall Sound appeared to be of particular importance to this species. Bearded Seals were also observed to concentrate along the east coast of Melville Island early in the season. Few seals were observed in the marine channels (Prince Regent Inlet, Peel Sound, etc.) south of Barrow Strait. In almost all cases Bearded Seals were found in nearshore areas where it was presumed that productive benthic communities existed. The stomach of an adult Bearded Seal that was examined at Creswell Bay on 8 August was found to contain a large quantity of the common bivalve *Serripes groenlandicus* along with a few benthic crustaceans and sculpins.

The presence of Bearded Seals at breathing holes distant from areas of open water in early June (e.g., McDougall Sound) suggests that a portion of the population may winter in the Polar Gas study area; the 1975 data indicate that an influx occurred during ice break-up in late June.

Walrus

The distribution of Walruses before and during ice break-up in Barrow

Strait suggested that at least some individuals winter in the Queen's Channel/Penny Strait area. It is not known if the large numbers of Walruses in Crozier Strait are part of this overwintering group or if they represent migrants arriving from Lancaster Sound and Barrow Strait during ice break-up. Small numbers of Walrus (maximum of 10 on 7 June) were found along the East Barrow ice edge between Cape Clarence to west of Maxwell Bay during June; following ice break-up in June, Walrus were observed along the SW coast of Devon Island and in southern Wellington Channel. In 1975, a total of 130 individuals were observed in East Barrow Strait during 5 surveys between 7 and 18 July; most of these were on SW Devon Island. In late summer over 200 were observed to concentrate in Crozier Strait; 194 were observed at a terrestrial haul-out site at Brooman Point along the W coast of Bathurst Island. [This site was also used in 1974 and 1976.] Only a few scattered individuals were observed in the marine channels (Peel Sound and Prince Regent Inlet) south of Barrow Strait.

Beluga Whale

Belugas first appeared along the ice-edge in East Barrow Strait on 5 June; as East Barrow Strait began to break-up the whales moved westward. Small numbers of Belugas occurred at traditional concentration sites in bays as early as 9 July, but large concentrations did not form until after mid-July.

The major influx of Belugas into coastal areas became evident shortly after 20 July. It was estimated that in late July, there were 5500 Belugas in coastal waters of northern and eastern Somerset Island and about 2700 offshore in East Barrow Strait. At Creswell Bay, Belugas were first noted on 20 July; by 24 July, 3376 individuals were present. The maximum number recorded there was 3897 individuals on 14 August. A close examination of the Beluga herd at Creswell Bay showed a significant increase in the number of neonatal calves during the last week of July and the first two weeks in August.

Belugas vacated the coastal concentration areas between early and mid-August but it is not known where the animals were in late August. Although no surveys were done in September, it is suggested, on the basis of data from other observers, that Belugas migrate eastward through Lancaster Sound during freeze-up in September and October.

Within the Polar Gas study area, all the important concentration areas are located along the coasts of East Barrow Strait and Prince Regent Inlet. The major concentrations observed in 1975 are given below.

Location	Individuals	Location	Date
E Barrow Strait			
Devon Island	700	Erebus Bay	21 Aug.
	450	Radstock Bay	21 Aug.
N Somerset Island	142*	Cunningham Inlet	27 July
	297	bay 10 mi NW of Garnier Bay	27 July
	1000	Garnier Bay	27 July
	210	20 mi ENE of Garnier Bay	21 July
Prince Regent Inlet			
Somerset Island	944	Elwin Bay	3 Aug.
	3897	mouth of Creswell R., Creswell Bay	14 Aug.
	963	SW Creswell Bay (20 mi NW of Cape Garry)	27 July
	175	20 mi NNE of Ft. Ross	31 July
	456	15 mi NNE of Ft. Ross	31 July

* Many fewer than in some years.

Narwhal

In 1975, Narwhals were observed in N Prince Regent Inlet as early as 5 June. Narwhals moved into Barrow Strait soon after the ice

broke up in late June. All 132 Narwhals observed during fixed-wing surveys in early summer (25 June-24 July) were in offshore waters of Barrow Strait or the adjacent waters of Wellington Channel; an additional 31 were seen in Bellot Strait on 24 July during helicopter surveys. In late summer (25 July-24 August), a total of 57 Narwhals were recorded; about half of these were in East Barrow Strait and the remainder were in Peel Sound, Bellot Strait and Creswell Bay. The total population of East Barrow Strait, the most heavily utilized area in 1975, was estimated to be small (200-400 individuals) based on the systematic cross-sound transects flown on 17-18 and 27-28 July. A small concentration was noted in Creswell Bay in 1974 and 1975 (maximum 70 on 10 August); in 1974 an estimated 500 occurred in northern Peel Sound in early August. In contrast to Belugas, most Narwhals sighted were in offshore waters. Many were close to ice.

Bowhead Whale

The report gives three sightings totalling 8 animals--at the mouth of Wellington Channel (1 individual), N Prince Regent Inlet (2 individuals), and the vicinity of Creswell Bay (5 individuals).

- Finley, K.J., R.A. Davis and W.J. Richardson. 1974. Preliminary studies of the numbers and distribution of marine mammals in the central Canadian Arctic--1974: a preliminary report. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 68 pp.

This report summarizes the observations of marine mammals recorded during aerial surveys for birds in the channels among the central Arctic islands during June, July and August 1974. Few surveys were flown during July so that most observations are for June and August. Specific areas covered included coasts from eastern Melville Island east to western Devon Island; the N, E and SE coasts of Prince of Wales Island; all coasts of Somerset Island and the Boothia Peninsula; and parts of the adjacent channels. All aerial surveys were flown at 100-150 feet A.S.L. and with a transect width of 1/4 mile. The aerial surveys were specifically designed to survey bird distribution; hence mammal observations were recorded incidental to the main objective of the study.

The information presented in this volume is considered tentative. Additional information on mammal distribution and survey techniques during the 1974 season is contained in Davis *et al.* (1975). A more intensive study specifically aimed at documenting mammal distribution was conducted in 1975 (Finley 1976). These results are considered more conclusive and hence have been emphasized in this bibliography. Only a brief summary of Finley *et al.* (1974) is given here.

Major Findings

Ringed Seal

Because the surveys were conducted for birds, few areas of extensive fast-ice were surveyed; such areas are the best areas in which to obtain counts of Ringed Seals during the spring and early summer when they haul-out on the ice to bask.

The highest densities of Ringed Seals were recorded along the S coast of Cornwallis Island, the NW coast of Somerset Island and in the offshore area of West Barrow Strait.

During June, the maximum Ringed Seal densities on single transects were recorded between Cornwallis Island and Browne Island (29.0 seals/sq mi), off NW Somerset Island in the Aston Bay area (22.3 seals/sq mi) and between Cornwallis Island and Griffith Island (20.7 seals/sq mi).

No conclusions were drawn from observations during August (few surveys were done in July) since seals are difficult to survey during the ice-free period.

Harp Seal

Harp Seals were not observed during June nor during the few surveys that were conducted during July; during August a total of 287 individuals were observed. Three-quarters of these were in northern Peel Sound on

3 August. The largest herd (of 60) was observed in Barrow Strait between Griffith and Limestone Islands on 11 August. The most westerly record was an individual off SE Bathurst Island on 22 August.

Bearded Seal

A total of 99 was recorded during the study. Most of the 27 observed in June were along ice edges in Queens Channel and Penny Strait. Of the 72 individuals observed in August many were found in McDougall Sound (39%) and along the northeast coast of Prince of Wales and Russell Islands (24%).

Walrus

Walrus were present in the study area when surveys began in June. During June, most animals (63%) were observed in Queens Channel. The second most important area was Barrow Strait where 63 individuals were observed during early June; most of these were along the SW coast of Devon Island.

During August, the largest numbers observed were in the Queens Channel/McDougall Sound area and along SW Devon Island; a herd of 65 was observed hauled-out on a gravel beach near Innes Point, Devon Island, on 2 August. [A nearby haul-out site was reported in 1949 (Gunn 1949).]

Beluga

Only 84 individuals were recorded during June; over 95% were along fast-ice edges and most were along SW Devon or SE Cornwallis Islands.

Belugas were highly concentrated during August. The largest number observed in a single area was 1100 at Cunningham Inlet, N Somerset Island, on 2 August. The maximum number observed at Creswell Bay was 900 but the area was very incompletely surveyed. J.D. Heyland of Quebec Wildlife Service photographed the whales in Creswell Bay on 27 July 1974 and found 3,464 Belugas present there.

In general, the single most important coastline for Belugas in August was northern Somerset Island from Limestone Island to Gifford Point; 33% of all individuals observed in August were in this area.

Narwhal

The first Narwhal was observed on 14 June; only 4 other individuals were observed during June. All of these were in Barrow Strait. A total of 572 individuals were observed in August. The majority (91%) were counted along the ice-edge in West Barrow Strait and Peel Sound on 3 August. Narwhals were recorded west to McDougall Sound and north to Baillie-Hamilton Island.

Bowhead Whales

None was positively identified in 1974.

● Greendale, R.G. and C. Brousseau-Greendale. 1976. Observations of marine mammal migrations at Cape Hay, Bylot Island during the summer of 1976. Fisheries and Marine Service Tech. Rept. No. 680. 25 pp.

This report summarizes the information obtained during watches for marine mammals migrating along the north shore of Bylot Island approximately 8 km west of Cape Hay from 21 June to 31 July 1976. The study was specifically intended to document the migration of the Narwhal and compare the results with those of a migration watch in 1957 (see Tuck 1957). Observations of Harp Seals, Bearded Seals, Bowhead Whales, Belugas, Walruses, Hooded Seals, Harbour Seals and Polar Bears were also recorded and compared with Tuck's data.

The observations reported by Tuck (1957) provided the major source of information on which the present estimates of Narwhals in Lancaster Sound and Barrow Strait are based. Northern Bylot Island provides an excellent vantage point from which to census that part of the population that migrates along the southern edge of eastern Lancaster Sound. This monitoring of the movements of Narwhals and other marine mammals through Lancaster Sound via northern Bylot Island was an attempt to determine if population declines had occurred for any of the species during the 19-year period 1957 to 1976. The census may be regarded as the only land-based marine mammal survey against which to evaluate further changes in the numbers of Narwhals and other marine mammals utilizing Lancaster Sound.

Narwhals and several other species of marine mammals migrate along the north coast of Bylot Island during a relatively short period; during this time they appear to be concentrated within a few kilometres of shore. In 1976 a 24-hour seawatch was conducted, when weather permitted, from the 800-foot cliff overlooking eastern Lancaster Sound. With the aid of binoculars and a spotting scope, marine mammals were identified and recorded.

The major limitation in this study was the intermittent nature of the seawatches due to adverse weather conditions. Heavy fog and snow during the peak of the Harp Seal migration may have resulted in the small number of Harp Seals observed relative to Tuck's estimates in 1957. Other variables influencing detectability of marine mammals included ice-conditions, wave-height and glare.

It was concluded that the number of Narwhals migrating past Cape Hay was about 8000 to 10,000, similar to the number seen in 1957. Only 16,000 Harp Seals were observed compared to 136,000 in 1957; this difference was attributed to a later migration in 1976 (observations ceased on 31 July when Harp Seals were still migrating) and possibly to effects of adverse weather conditions on visibility. Hence no assessment was made of the Harp Seal population.

More Beluga Whales (183 in 1976 vs 30 to 40 in 1957) and Bowhead Whales (23 vs 3) were observed in 1976 than in 1957. A significant westward movement of Bearded Seals past Cape Hay was observed during late July. Walruses, Ringed Seals, Harbour Seals, Hooded Seals and Polar Bears were recorded in small numbers.

[The data collected in 1957 and 1976 must be compared and interpreted with caution since it is not known what yearly variation exists in the habits of migrating sea mammals. Furthermore, a number of variables (particularly weather) affect the detectability of marine mammals during seawatches. This is particularly critical here since the majority of the Narwhals and Harp Seals may pass on only one or two days. On three occasions in 1976, adverse

weather conditions resulted in abandonment of the watches for periods of more than 48 hours. Tuck was also conducting a major seabird study and his observations were less likely to be complete than those of the Greendales who attempted to observe full-time. Hence it is probable that Tuck recorded a smaller fraction of the animals passing Cape Hay.

A further limitation of the seawatches as a basis for population estimates is that an unknown but potentially important fraction of the migratory mammals that enter Lancaster Sound do so far offshore or along the north coast--out of range of an observer on Bylot Island (Johnson *et al.* 1976b; R.R.C.S. 1977). Hence, the main value of these surveys is to establish minimum population estimates for southern Lancaster Sound during the two years 1957 and 1976.]

- Harington, C.R. 1962a. Polar Bear study: east coast of Baffin Island, 1961. Arctic Circular 15:21-23.

This is a brief report describing a field expedition to locate Polar Bear dens between Scott Inlet and Cape Hooper near Clyde River. There was a distinct movement of Polar Bears to the vicinity of Clyde Inlet in November; this area was concluded to be a major denning area. There was great variability in denning habits among individual bears. The first male bears to occupy dens were usually found in ice bridges over dry stream beds (below 400 ft ASL). Some bears occupied dens from September to November or later; others did not den during this period. Females usually moved into dens in late September or early October; their dens were usually on drifted leeward slopes and were at an average altitude of 1200 feet.

- Harington, C.R. 1962b. Polar Bear study--Resolute Bay area, N.W.T., 1962. Can. Wildl. Serv. Unpubl. Rept. 38 pp.

This report summarizes the observations made and data collected during a Polar Bear collecting trip by sled in the Resolute Bay area from 11 March

to 2 June 1962. Most of the information on behaviour and measurements is outside the scope of this bibliography.

Harington's most relevant findings relate to Polar Bear distribution. He found that bears were most common from March to May in areas of heavy pressure ice and ice fractures. In Barrow Strait, this habitat occurs on the northern and southern sides (especially at Griffith, Baker, Lowther and Limestone Islands); the area north and east of Russell Island is also heavily utilized by bears during the spring. Pressure ridges are preferred hunting areas because of the presence of maternity dens of seals.

Harington found that flat, solid expanses of ice such as occur in the central portions of Barrow Strait were seldom occupied by bears for long periods.

● Harington, C.R. 1966. Extralimital occurrences of walruses in the Canadian Arctic. J. Mamm. 47:506-513.

Harington reports on 33 occurrences of the Walrus beyond its normal range. The normal range is shown to include all of Baffin Bay, Lancaster Sound (and adjacent bays and inlets), East Barrow Strait, Prince Regent Inlet and Wellington Channel.

The distribution of the Walrus is based on three ecological requirements:

1. a large amount of almost continually open water in coastal areas,
2. gravel or mud bottoms at depths between 15 and 80 metres which support molluscus (*Cardium*, *Mya* and *Saxicava*) that are the main diet, and
3. suitable hauling-out sites.

- Hay, K. 1976. Preliminary report on Narwhal studies in Northern Baffin Island. Summer 1976. Unpubl. Rept. Fisheries and Marine Service, Ste. Anne de Bellevue, P.Q. 8 pp.

This report concerns research on marine mammals during the summer of 1976. It is a progress report and includes few results. Reports of two related projects in 1976 have been written (Greendale and Brousseau-Greendale 1976; Silverman 1977).

It is estimated that the hunter take of Narwhals was at least 125 at Pond Inlet and 100 at Arctic Bay in 1976.

- Hay, K. and R. McClung. 1974. Observations on Beluga and Narwhal in the Canadian High Arctic, Summer 1974. MS Rept. No. 1385, Fisheries and Marine Service, Arctic Biological Station, Ste. Anne de Bellevue, Quebec, 55 pp.

This report summarizes observations of Beluga numbers and behaviour in Cunningham Inlet, Somerset Island from 24 July until 8 August 1974. Belugas that concentrated at the mouth of Cunningham River were observed from a 20-foot scaffold. Population estimates were obtained from a high hill at the southwest corner of the inlet. Results of aerial surveys over southwest Devon Island, from Resolute to Pond Inlet and in the Oaormak Hunting area along the W coast of Eclipse Sound are also included. All surveys were essentially reconnaissance in nature and no estimates of population densities were derived. Too few aerial surveys of Navy Board Inlet and Eclipse Sound were conducted to indicate the status or the numbers of Narwhals using these areas.

Major Findings

1. The first Belugas (15-20 individuals) were observed in Cunningham Inlet on 21 July, the first day that the ice had broken sufficiently to permit entry. The population in the inlet peaked at 1000+ on 6-7 August.

2. An increase in the number of young Belugas in Cunningham Inlet during the period of observation provided circumstantial evidence that the inlet was a calving area. It is suggested that the whales calve in the relatively warm water of the river mouth to reduce thermal shock to the new-born whales.
3. One Beluga stomach was obtained; it contained amphipods and seaweed.
4. Aerial surveys along the SW coast of Devon Island on 10 August located 465 Belugas in offshore shallows between Cape Hurd and Gascoyne Inlet.
5. Estimates are presented for Narwhals observed in various areas of N Baffin Island during aerial surveys on 12 August. One hundred and eighty-two Narwhals and 2 Belugas were recorded in Admiralty Inlet; the most southerly observation was of one Narwhal in a lead SW of Yeoman Island. A total of 174 Narwhals were recorded in SW Eclipse Sound and Milne Inlet; the most southerly observation was of 131 off Bruce Head at the mouth of Koluktoo Bay.

● Hay, K. and D.E. Sergeant. 1976. Interim Technical Report, Arctic Whale Project, Environmental--Social Program, Northern Pipelines (Arctic Islands Pipeline). Fish. Res. Bd. of Canada. 41 pp.

This report summarizes field work conducted on Belugas and Narwhals in Lancaster Sound and adjacent regions during 1975. The studies consisted of aerial surveys and collection of samples from the hunts at Arctic Bay and Pond Inlet. The major findings relate to the population census.

Major Findings

About 100 Narwhals and 1000 Beluga whales were observed along the ice-edges in Prince Regent Inlet and Lancaster Sound in early June 1975. The authors suggest, on the basis of work by M. Lawrence, Fisheries and Marine Services, Freshwater Institute, Winnipeg, that the population of Narwhals in Admiralty Inlet was 5000 to 7000 in July-August, 1975; however, there is no indication of the methods used to determine this figure.

● Johnson, S.R., W.E. Renaud, R.A. Davis and W.J. Richardson. 1976b. Marine mammals recorded during aerial surveys of birds in eastern Lancaster Sound, 1976. Unpubl. Rept. by LGL Ltd. for Norlands Petroleums Ltd. 180 p.

This report summarizes observations of marine mammals in E Lancaster Sound during bird surveys from May to September 1976. The study area and survey design is described in Johnson *et al.* 1976a.

This report presents only results; discussion and interpretation of these results are not included and reference to the literature is minimal. It is stressed in the introduction that surveys flown at different altitudes produce population indices which are not directly comparable. Hence the quantitative findings of other investigators (particularly RRCS 1977) cannot be related directly to the results presented here.

The following summary of material in the above report by Johnson et al. has become available since the bibliography was first printed.

Beluga

Belugas were present in the study area when surveys began on 1 May. They were recorded regularly until late July; few were recorded during August and early September. Large numbers were present during the last three weeks of September.

Small numbers (49 and 18 individuals) were recorded during the two surveys in the first half of May; the numbers then increased and on the five following surveys from 16 May to 15 June the numbers seen remained fairly constant (124-142 individuals). An increase was evident by 20 June; these numbers remained relatively high until mid-July (maximum of 487 individuals in early July). A gradual decline occurred during the last half of July. Only three individuals were observed during five surveys between 26 July and 12 September. On 12 September one group of 300 individuals was observed; on the following week a total of 2,592 individuals were recorded in the study area (1,009 were recorded during actual survey). A total of 320 were recorded in the study area on 26-28 September.

During spring migration, May to July, the distribution of Belugas migrating westward appeared to be determined by ice conditions. During May, most Belugas were recorded along the Devon Island coasts ice-edges on transects flown 200 m and 1000 m from the interface. One 6-7 June when the lead along Baffin and Bylot Island was opened by southerly winds (and the Devon lead closed), all Belugas were recorded in S Lancaster Sound. As the pack-ice began breaking up on subsequent surveys, Belugas were observed along both margins of the study area.

During the eastward fall migration (12-28 September), virtually all Belugas (except for two individuals which were seen near the Wollaston Islands) were observed along the coast of Devon Island. Almost all of the 3,207 individuals observed in the study area during the fall migration were in three large herds: 300+ individuals near Dundas Harbour on 12 September, 2,500 (922 counted during regular bird surveys--larger estimate made from high level flight) in Queen Harbour on 19 September and 293 in Croker Bay on 26-28 September.

Most Belugas were recorded in coastal areas (0-400 m from coast or ice-edge) and nearshore areas (800-1200 m from coast or ice-edge) during both spring migration (88% of on-transect individuals) and fall migration (98% of no-transect individuals). It is stated that due to the small amount of off-shore habitat sampled (only 3%) the significance of the off-shore areas of Lancaster Sound is greatly underestimated.

Narwhal

Narwhals were first observed on 16 May; numbers increased during subsequent surveys and peaked in early July. Decreasing numbers occurred until late July. With the exception of one large group observed in early September, only scattered individuals were observed again until late September when the largest number recorded during the entire study occurred.

The number recorded from mid-May to late June gradually increased (with small variations between surveys) to 160 in the third week of June;

a peak of 550 individuals was observed during 4-5 July. As the numbers of Narwhals declined in the study area during July, increasing numbers were recorded in Admiralty Inlet between Arctic Bay and Elwin Inlet. A total of 142 were recorded in late July. During the five surveys between 26 July and 5 September only 11 Narwhals were recorded in the study area.

In September, only one large group (245 individuals swimming W near Cape Charles York on 5-7 September) was observed until 8 September when a large eastward migration of at least 896 individuals was observed; most of these were in mid-sound.

Narwhals were common along both margins of eastern Lancaster Sound during both spring and fall migration. During the spring migration (13 June to 10 August) about 88% of the individuals and 75% of the groups observed on-transect were on coastal and nearshore transects. Since a disproportionately small amount of the total off-shore area was surveyed, it is expected that the numbers present in the off-shore areas is large and may, in fact, exceed the total numbers present in coastal and near-shore areas.

All except 12 of the Narwhals observed on-transect during September were noted on the 26-28 September survey; approximately 50% of these were observed during cross-sound transects indicating that the fall migration does not follow coastlines as closely as does the spring migration.

Total estimates for the study area were calculated for three surveys because a large number of individuals were in off-shore waters where they could be more systematically censused on cross-sound lines and/or because they probably represented peak populations in the study area. A correction factor was applied to correct for lower numbers observed by the left-rear observer. Densities were considered separately in coastal areas (0.0-0.4 km from shore or ice-edge) and off-shore areas (more than 7 km from shore or ice-edge). Extrapolations were made for the areas in between these zones.

The estimates for 21-21 June were 1,218; 4-5 July were 2,566 and 26-28 September were 6,925 individuals. In all three cases, the off-shore

environment (areas more than 7 km from shore or ice-edge) contained the majority of the individuals estimated to be present.

Bowhead Whale

Nineteen Bowhead Whales were recorded in the study area. Two individuals were observed in May, 10 in June, four in July, one in August and one in September. All were single individuals except for two instances when two associated animals were seen. Fourteen of the nineteen individuals observed were seen during cross-sound transects.

Polar Bear

Observations of 173 Polar Bears are reported. These included 104 observed by prime observers during aerial surveys, 59 observed by the third observer or incidentally during ferrying flights and 10 observed during work aboard the research vessel *Theta*.

Observations were broken down into three periods in the report. No obvious concentrations were observed from 2 May to 7 June when Lancaster Sound was largely filled with ice; 31% were on off-shore pan-ice, 17% were in nearshore areas and 53% were on landfast ice. During surveys from 13 June to 10 August, the proportions in these three habitats were 2%, 15% and 83%. Polar Bears were concentrated on the fast-ice S of Philpots Island and in Croker Bay where land-fast ice persisted late into the summer. Little fast-ice remained during the last period, 16 August to 28 September, when 61% of the 44 bears observed were along coasts. Most of the other bears occurred on off-shore pan-ice that was drifting through the study area in late August and early September. Again, the coast of Devon Island supported more bears than did the coasts of Baffin and Bylot Island; however no concentrations were observed.

Walrus

Walrus were observed during every survey from early May to late September. Small numbers were present until mid-June when numbers began

to increase. Peak numbers occurred during July with a decline being evident during August and September.

During the period of peak numbers, 13 June to 10 August, 67% of the on-transect individuals were in coastal habitats and 21% were in near-shore habitats. The densities of Walrus on nearshore transects and off-shore transects of Devon Island were significantly higher than along the corresponding areas along the coasts of Baffin and Bylot Islands.

Croker Bay was the single most important area for Walrus in the entire study area; 39% of all observations for the 13 June to 10 August period were from Croker Bay. The largest group observed here was 20 individuals on 19 July. No terrestrial haul-out sites were observed in Croker Bay. Other areas with significant Walrus populations are Dundas Harbour (where at least two terrestrial haul-out sites occur, one on an island end, one on a peninsula) and near the Wollaston Islands; 30 were observed hauled out on a pan at the latter location on 26 July 1976 (observation by M.S.W. Bradstreet from *Theta*).

During the 13 June to 10 August period, the Walrus groups showed a significant tendency to occur along fast-ice interfaces with pans.

The pattern of use of the Devon coast continued during the last period, 16 August to 28 September.

Harp Seal

Harp Seals were first recorded on 4 July; this vanguard represented the start of the peak westward migration. Large numbers were recorded during July followed by small numbers in August. The species was again recorded in large numbers in early September with moderate numbers present in the last half of the month.

The most important area during July was Navy Board Inlet; the peak density along the ice-edge was 44.4 seals/sq km on 5 July. Significant numbers of Harp Seals occurred along the Croker Bay ice-edge, Devon Island in late July (11.9 seals/sq km).

No significant concentrations occurred during August.

On 507 September a total of 2,811 individuals were hauled out on ice pans at the N end of Navy Board Inlet, but because most were off-transect, the densities were low. Few Harp Seals were again observed in Navy Board Inlet until late September. Croker Bay was a major concentration area throughout September.

Hooded Seal

One was seen on 30 August and three were seen on 5 September hauled out on pans at mid-sound between Croker Bay and Cape Joy.

Ringed Seal

A total of 1,274 Ringed Seals were observed during aerial transects; they were recorded on every survey. Largest numbers were recorded from 30 May to 15 June, during the peak haul-out period; the maximum density recorded was 2.5 seals/sq km. About 69% of the seals recorded during this period were in off-shore habitat (the mean density was 0.21 seals/sq km); on nearshore transects the mean density was 0.13 seals/sq km; on nearshore portions of cross-sound transects the mean density was 0.10 seals/sq km; on coastal transects it was 0.11 seals/sq km.

Important areas of fast-ice were near Cape Joy and the entrances to Croker Bay and Navy Board Inlet. The highest densities recorded during the entire study (2.5/sq mi and 2.3/sq mi) were recorded on nearshore and coastal transects adjacent to the Croker Bay ice-edge.

After correcting for differences in detectability of seals from rear seats, the estimated number of Ringed Seals present during the peak haul-out period (30 May to 15 June) was 3,970 individuals.

Bearded Seal

Seventy-four Bearded Seals were recorded during aerial surveys. No

seasonal fluctuations in numbers were evident. During the ice season (May and June), Bearded Seals were most frequently observed hauled-out on pans in off-shore areas; during the open water season (July to September), the species was usually observed in coastal and nearshore areas.

- Jonkel, C. 1975. Lancaster Sound--Admiralty Inlet Polar Bear studies. Unpubl. MS Rept., Canadian Wildlife Service, Ottawa. 22 pp. + figures.

The report was completed in response to requests for baseline data on the Polar Bear in the Strathcona Sound--Admiralty Inlet area. Such information was considered necessary because of plans for development of a lead-zinc mine on the south shore of Strathcona Sound. This report incorporates the information presented by Harington 1963, and provides much previous unpublished information that had been gathered up to 1975. This report is concerned with Polar Bears in a large area including Prince Regent Inlet, Lancaster Sound, Navy Board Inlet and Milne Inlet.

Surveys of bears were conducted by helicopter with methods adapted to weather and light conditions. Behavioural studies were conducted from Caswell Tower at Radstock Bay on SW Devon Island (See Stirling 1974). Bears were captured, wherever possible, during helicopter surveys; these animals were marked and various statistics were recorded using standard techniques. Data on hunter kill were gathered from hunters, Hudson's Bay posts, Inuit Co-ops and R.C.M. Police. Denning areas were located during helicopter surveys in April when bears left their dens, and in August when pregnant females tended to congregate in denning areas. Notes on species of animals and birds observed incidentally to the surveys are included on the accompanying maps.

Major Findings

Polar Bears were concentrated in three areas in Lancaster Sound:

1. along the south Devon Island coast,
2. in a triangular area with vertices at Beechey Island and Maxwell Bay (both on SW Devon Island) and at Cape Clarence (Somerset Island),
3. along the floe edge at the north end of Prince Regent Inlet.

Jonkel estimates that from March to June (and probably also during January and February) of most years there are at least 1000 Polar Bears in areas 2 and 3 (above). Low intensity of hunting in these areas and, probably more importantly, the presence of a floe-edge and consequent large numbers of Ringed and Bearded Seals are the reasons suggested for this large concentration. Furthermore, the two recurring floe-edges (i.e., from Maxwell Bay to near Prince Leopold Island and across the N end of Prince Regent Inlet) are considered to be among the most productive marine areas in the Canadian high Arctic.

When the floe-edge extends unusually far west to Griffith Island (as in 1967-68, 1973-74 and 1975-76) the Polar Bears are displaced southward and unusually large numbers may occur in northern Prince Regent Inlet. During such years the densities may also be higher than average along the Wellington Channel ice edge.

It is suggested that 'the year-round extension of the North water to the Prince Leopold Island--Maxwell Bay floe-edge....precludes the use of much of Lancaster Sound by Polar Bears except during May-July when the channel is filled with ice floes.' [Recent LANDSAT imagery indicates that although the ice of Lancaster Sound is in intermittent restricted motion during the period November to May, it is >90% frozen. Hence Polar Bears should not be excluded from the area for the reasons listed by Jonkel.]'

Bears marked in E Barrow Strait/W Lancaster Sound were never taken by hunters from Arctic Bay; similarly bears marked at Philpots Island were never taken by hunters from Pond Inlet. It is concluded that movements of the population in Barrow Strait and Lancaster Sound are restricted during the entire year and that bears in this area represent a distinct subgroup. Similarly, the bears of Admiralty Inlet and Navy Board Inlet also represent a distinct subgroup.

Maternity denning in the Lancaster Sound area is poorly known. Known denning areas include (1) northern Borden and Brodeur Peninsulas on Baffin Island, (2) northern Bylot Island and (3) SW Croker Bay, inner Powell and Cuming Inlets and NE Maxwell Bay on Devon Island. Suspected denning areas include much of southern Devon Island, NE Somerset Island and Steensby Peninsula in SE Admiralty Inlet.

Observations of marine mammals obtained incidental to Polar Bear studies in the Lancaster Sound area provide some additional information. The most significant of these records are listed in Table a.

Table a: Records of Marine Mammals Observed Incidental to Polar Bear Surveys in the Lancaster Sound area in 1974.¹

Beluga	100	14 May	SE of Maxwell Bay
Beluga	300	8-9 August	Radstock Bay
Beluga	200	8-9 August	E Maxwell Bay
Beluga	500	8-9 August	E Maxwell Bay
Beluga	20	8-9 August	E Maxwell Bay
Walrus	2	15 May	Cape Crauford, NE Brodeur Peninsula
Walrus	40	8-9 August	Inner Croker Bay
Walrus	2	8-9 August	Off Cape Warrender
Ringed Seal	'large nos.'	May	N Prince Regent Inlet
Ringed Seal	'large nos.'	May	N Admiralty Inlet
Ringed Seal	'many'	August	Central Maxwell Bay
Harp Seal	100	August	Central Admiralty Inlet
Narwhal	100	August	Central Admiralty Inlet
Narwhal	200	August	Eclipse Sound

¹ From Jonkel 1976.

- Loughrey, A.G. 1959. Preliminary investigation of the Atlantic Walrus, *Odobenus rosmarus rosmarus* (Linnaeus). Canada Wildl. Serv. Bull. 14:1-123.

This report presents the first major summary of the life history of the Walrus in Canada. It is based on field work carried out in northern Hudson Bay from 1952 to 1954, and on the available literature. The status of the Walrus in Lancaster Sound and adjacent areas is given.

'Walruses have been reported from the waters surrounding Devon Island and from farther west in Barrow Strait to the W side of Cornwallis Island at least.

'From Lancaster Sound they apparently drift southward on the ice down Prince Regent Inlet. They were formerly reported common at Port Leopold and Fort Ross (Learmouth, interview, 1952). Ross (1853) reported them from N Prince Regent Inlet but said that they did not occur in the Gulf of Boothia. Until recently this was believed to be still the case, but Father Van de Velde, O.M.I. informed the writer in 1953 that a few are found in Lord Mayor and Thom Bay, on the west side of the gulf. Constable Sargent of the R.C.M. Police reported a walrus shot in 1951 near Ross Peninsula on the south side of Lord Mayor Bay. It was previously noted that they have been recorded from Crown Prince Frederick Island.'

[Most of what is known about feeding habits in the arctic region is taken from data gathered in NW Greenland (see Vibe 1950). A more recent account of Walrus life history is presented in Mansfield (1973).]

- Mansfield, A.W. 1958. The Biology of the Atlantic Walrus (*Odobenus rosmarus rosmarus* Linnaeus) in the Eastern Canadian Arctic. MS Dep't. Fish Res. Bd. Canada. 146 pp.

This paper is the earliest relatively complete study of the Atlantic walrus in Canadian waters. Loughrey (1959)--which was written in 1955--presented preliminary information on the walrus in northern Hudson Bay but Mansfield (1958) presented a much more complete analysis of the biology of this population. The paper discusses aspects of the ecology and biology of the walrus population in northern Hudson Bay and Foxe Basin; the field work was conducted from 1953 to 1956. Hence the main volume of information obtained was from outside the Lancaster Sound study. This paper is included here because no detailed studies of the biology of the walrus have been conducted in the Lancaster Sound area.

Major Findings

The authors abstract summarizes the major point of this paper: 'Males mature at six year old and appear here in rut from November to May, the peak of breeding activity occurring in April and early May. The youngest sexually mature females are five years old, though the majority do not become mature until seven years. The gestation period lasts just over a year, and the majority of calves are born in April, May and June. The low annual birth rate of 0.35 calves per adult female is counter-balanced by great maternal solicitude for the calf with a correspondingly low mortality.'

- Mansfield, A.W. 1967. Seals of arctic and eastern Canada (2nd ed., revised). Fish. Res. Bd. Canada Bull. 137:1-35.

This publication provides general information on the pinnipeds that inhabit eastern and arctic Canada; it is 'intended to provide a means of identifying the seals...and a summary of the more important facts of their life histories'. Relevant information on food habits, migration and population sizes is extracted.

Major Findings

Harbour Seal

This species is widely distributed in E Canada north to Baffin Bay and Davis Strait; local occurrence records are shown for Pond Inlet and Arctic Bay. Little is known of the diet of arctic Harbour Seals.

Harp Seal

After the period of breeding and moult, Harp Seals move northward into arctic waters. In the spring and summer the adult seals eat mysids, euphausiids, Arctic Cod, capelin, herring, squid and occasional groundfish while immature seals feed on planktonic crustaceans (mysids and euphausiids). The principal migration route extends through Lancaster Sound and Barrow Strait west to north of Russell Island, north to near Baillie-Hamilton Island and south to central Peel Sound, and through Prince Regent Inlet. [Recent studies in the central Arctic (Finley *et al.* 1974; Finley and Johnston 1977) tend to support this range description.]

The Canadian population was estimated to number 3,000,000 in 1951; large catches during the following years led to a decline and the population was only 1,250,000 in 1960. [Sergeant (1976) provides additional information on populations.]

Hooded Seal

Two populations are known, one off E Greenland and another W of Newfoundland and SE of Labrador. [A third population has recently been

found in Davis Strait (Sergeant 1976).] The migration is shown to extend north to the eastern third of Lancaster Sound. Adults are known to eat redfish, Greenland Halibut and squid. There are no published accounts of the diet of animals in the Lancaster Sound area.

Ringed Seal

Permanent resident and most common seal throughout the Arctic. The range is shown to include all of the eastern high Arctic and all of the area covered by this bibliography. Food consists of *Parathemisto*, *Mysis* and *Boreogadus saida* (Arctic Cod).

Bearded Seal

Inhabits areas throughout the Arctic north to the southern limit of permanent ice; it is shown to occur sparingly throughout the area covered by this bibliography. Molluscs such as *Buccinum* and *Cardium* [*Serripes*] form the major food items. Other foods include sea cucumber (Holothuroidea), shrimps, crabs, octopods, worms, fish eggs and Arctic Cod.

Walrus

The Walruses in the eastern Canadian Arctic and western Greenland are members of a geographically isolated population. The Walrus is shown to occur in most regions of the Canadian eastern Arctic; however, only relatively small numbers occur in Lancaster Sound, Barrow Strait and adjacent regions. Northern Peel Sound and central Barrow Strait represent the westernmost limit of the species' regular range. The diet is composed mainly of clams; other food items include whelks (*Buccinum*), sea cucumbers (Holothuroidea), shrimps (Hippolytidae and Crangonidae), hermit crabs (Eupaguridea) and a variety of worms.

- Mansfield, A.W. 1971. Occurrence of the Bowhead or Greenland Right Whale (*Balaena mysticetus*) in Canadian Arctic Waters. J. Fish. Res. Bd. Canada 28:1873-1875.

This paper summarizes a large number of observations of Bowhead Whales over the 15 years prior to 1971. The former range included all of Lancaster Sound, Barrow Strait, Wellington Channel, Prince Regent Inlet, Admiralty Inlet, Navy Board Inlet, Eclipse Sound, Pond Inlet and northwest Baffin Bay. Recent observations (without more specific information as to date or number) were recorded near Cape Hay and SE Bylot Island; Resolute Bay, Cornwallis Island; Fort Ross, Somerset Island; and in Navy Board Inlet and Pond Inlet between Baffin and Bylot Islands.

Based on the observations, it is suggested that 'the Bowhead population is recovering well after intensive exploitation up until the early years of the present century, though it may amount to only a small percentage of the population present before commercial whale fisheries began.' The paper does not provide any quantitative evidence to support the suggestion.

- Mansfield, A.W. 1973. The Atlantic Walrus *Odobenus rosmarus* in Canada and Greenland. Int. Union Cons. Nat. Suppl. paper 39:69-79.

This paper is a summary of the life history and populations of the Walrus in Canada and West Greenland. The major points of the paper that relate to the eastern High Arctic population are presented below.

The Walruses of the eastern Canadian Arctic and western Greenland are one of three geographically isolated populations. Relatively small numbers of the population in the eastern Canadian Arctic use the Lancaster Sound area and other channels of the Archipelago. Migrating Walruses regularly penetrate into Lancaster Sound as far west as Bathurst Island and stragglers have been reported to penetrate as far as Prince Patrick Island and Melville Island. In most areas, Walruses are sedentary animals; however, migrations are also known to occur in the population that inhabits Baffin Bay. Little

information is available to indicate how the movements of Greenland Walruses are related to the occurrences of Walruses in Lancaster Sound and vicinities. [Freuchen and Salomonsen (1958) indicate that these movements involve the same animals.]

The diet consists largely of clams (*Mya truncata*) and cockles (*Serripes groenlandicus*); the Walrus also takes epibenthic invertebrates and fish when clams are not available. The maximum feeding depth is about 250 feet.

Males mature sexually when six years old; the females at four years. Females can bear young every two years but apparently most have young only every three or four years. The reproduction rate is about 11 percent. Birth occurs most frequently during mid-May. Calves become independent feeders during their third summer.

Little is known about the sizes of Walrus populations inhabiting the eastern High Arctic. The population at Holsteinsborg, west Greenland (which may include the Lancaster Sound population), has been heavily harvested and has declined markedly since the early 1940's following the introduction of motor boats. At that location, the harvest declined from 600 in 1940 to 19 in 1967. The activities of Norwegian Walrus hunters in Davis Strait between 1949 and 1952 (the last year that a ship-based hunt was allowed) accounted for the harvest of an additional 2,028 animals. At Thule, the annual catch of 130-170 individuals (including animals killed but not recovered) has had no apparent affect on the local numbers.

In summary, there is no estimate of the number of Walruses that inhabit or migrate through the Lancaster Sound area, but it is not believed to be large. Walrus movements are poorly understood. [Additional information relating to possible migration corridors and phenologies of the Lancaster Sound population may be found in Finley (1976).]

Mansfield, A.W., T.G. Smith and B. Beck. 1975. The Narwhal, *Monodon monoceros*, in eastern Canadian Waters. J. Fish. Res. Bd. Canada 32:1041-1046.

This paper reports the results of Narwhal research carried on in the Pond Inlet area during the summers of 1963, 1964, and 1965. During this period a total of 62 Narwhals were captured in nets and examined. Some aspects of the population status and catch are also discussed.

Major Findings

The major findings pertaining to this annotation are as follows. The few identifiable food remains in the stomachs consisted of squid and Arctic Cod. Calving is assumed to occur about once in three years. An estimate for the population in the eastern Canadian Arctic and northwest Greenland is 10,000; this figure is based upon a count of 6000 observed migrating along the coast of Bylot Island in 1957 (Tuck 1957) and another 2500 in the Thule area of Greenland. [Johnson *et al.* (1976b) found that Narwhals migrating through Lancaster Sound were not confined to the vicinity of the coast of Bylot Island, so Tuck's count may underestimate the population.] Although the annual birth rate is unknown, it is assumed to be similar to that of the Beluga--about 9.0%. Based on a population of 10,000 animals, the annual production is estimated at 900. It is estimated, on the basis of hunter kills in the major communities of the eastern Arctic and on sinking losses reported in west Greenland (of 50%), that the maximum annual kill may be 1154 individuals, which is considerably above the estimated annual production of 900.

- McLaren, I.A. 1958a. The economics of seals in the eastern Canadian Arctic. Fish. Res. Board Can. Circ. No. 1. 94 pp.

This report is a first attempt at an economic analysis of seal hunting in the eastern Canadian Arctic. As such, it is primarily aimed at providing a means of assessing potential seal production of particular areas. This analysis has numerous economic implications in terms of Inuit resource utilization.

The general lack of good information and the preliminary nature of this study is repeatedly stressed. The methods of assessing the quality of available fast-ice are based on a minimum number of seal surveys. More complete surveys for seals within the study area will test the assumptions that have been used to relate habitat quality to seal production.

Major Findings

McLaren has developed a scale in which good breeding ice within one mile of shore is presumed to support a population of 35 seals/sq mi; less suitable ice, 10/sq mi; and ice more than 10 miles offshore, 5/sq mi.¹ Hence, more complex coastlines (e.g., east coast of Baffin Island) support the largest number of Ringed Seals. Using these criteria, a population of about 1,000,000 Ringed Seals is estimated for the eastern Canadian Arctic south of Lancaster Sound and north of James Bay. Based on the ratio of Ringed to Bearded Seals on a small number of seal censuses (habitat preferences have not been clearly determined for Bearded Seals), 185,000 Bearded Seals are estimated to occur in this same area.

Potential Ringed Seal populations have been calculated for two areas within the interest of this annotation: (1) Admiralty Inlet (Cape Crauford to Cape Charles Yorke), and (2) Northeast Baffin Island, Navy Board Inlet to

¹Smith (1973a) states that these estimates are grossly inflated due to inclusion of peak counts obtained at Ney Harbour late in the season (an area of only 3.6 sq mi); seals likely moved to this area following general break-up of fast-ice in other adjacent areas. Smith (1973a), Finley (1976) and Smith *et al.* (1976) provide more information on seal densities in the eastern and central Arctic based on extensive aerial surveys.

Cape Adair (excluding outer Bylot Island). The estimated numbers of seals, based on the area of fast-ice, are approximately 43,900 and 66,300 individuals, respectively. [These values were calculated using the very high estimates of density quoted above.]

- McLaren, I.A. 1958b. The biology of the Ringed Seal (*Phoca hispida* Schreber) in the eastern Canadian Arctic. Bull. Fish. Res. Bd. Canada., No. 118. 97 pp.

Although all material and observations for this study are from areas outside the immediate areas covered by this bibliography, several findings are of direct interest to the life history and ecology of the Ringed Seal in the Lancaster Sound area. The main sources of information for this study were studies near SW Baffin Island and in N Foxe Basin. The major findings are taken directly from the abstract.

Major Findings

'At least 72 food species were identified; *Mysis oculata*, decapods, and *Boreogadus saida* were most commonly taken in inshore waters, while most off-shore seals feed on plankton, particularly *Themisto* [*Parathemisto*] *libellula* in SW Baffin Island. Food does not limit the range or abundance of this seal.

'The pup is produced...generally in early April, and may be attended until ice breaks up. Coastal configuration and latitude govern the amount of fast ice, its stability, and its snow cover, all of which determine the suitability of the area for pupping. More starvelings and small pups are produced on simple coasts, and the adult population of complex coasts is older and the seals are larger in size. There is an annual, small-scale migration, and dispersal of young seals from productive complex coasts to simple coasts. Ice conditions govern the distribution and abundance of the seal throughout the eastern Canadian Arctic.'

- McLaren, I.A. 1958c. Some aspects of growth and reproduction of the Bearded Seal, *Erignathus barbatus* (Erxleben). J. Fish. Res. Bd. Canada 15:219-227.

This paper is based on examination of 113 specimens from the eastern Canadian Arctic; an unspecified number of these were from N Baffin Island.

The average birth date in the eastern Canadian Arctic is 1 May. Males mature at age seven years; females at six years. There is probably a two-year pup cycle (i.e., mating occurs every second year).

- Miller, R.S. 1955. A survey of the mammals of Bylot Island, Northwest Territories. Arctic 8:167-176.

This paper is an annotated list of the mammals that occur in the Bylot Island area; although the literature is reviewed, the majority of the information presented was collected in 1954 during an expedition sponsored by the Arctic Institute of North America. Little quantitative information is presented, and the marine mammal population was subsequently documented in much greater detail by Tuck (1957) and Greendale and Brousseau-Greendale (1977).

Major Findings

Information on ice break-up in Pond Inlet and the arrival of Narwhals and Bearded Seals was provided by an Inuk from Pond Inlet (Table a). No mention is made of Harp Seals.

Miller provided the only evidence of the use by Walruses of the Wollaston Islands at the mouth of Navy Board Inlet. Miller never saw the site; but on the basis of Inuit reports, the population was estimated at 200 to 300 adults.

Some estimates of the numbers of whales that occur near Bylot Island are given based on information from Inuit. Bowhead Whales are seldom seen more than a few times each year. At least 10 to 20 Killer Whales are

seen in Eclipse Sound and Pond Inlet each August. From 100 to 200 Beluga Whales are seen along the floe-edge of Pond Inlet each June and July; from 10 to 15 occur irregularly, usually during August, in waters of Eclipse Sound. Narwhals follow the break-up of ice in Navy Board Inlet and Pond Inlet to converge in Eclipse Sound during August and September; from 500 to 1000 are seen along the south coast of Bylot Island each year.

Table a: Arrival Dates of Bearded Seals and Narwhals in Eclipse Sound in Relation to the Date of Ice Break-up.

<u>Year</u>	<u>Arrival of Narwhals and Bearded Seals</u>	<u>Date of Ice Break-up</u>
1946	30 July	11 August
1947	26 July	7 August
1948	1 August	28 July
1949	26 July	27 July
1950	25 July	23 July
1951	21 July	17 July
1952	25 July	4 August
1953	23 July	4 August
1954	18 July	7 August

● Milne, A.R. 1974. Use of artificial subice air pockets by wild Ringed Seals (*Phoca hispida*). Can. J. Zool. 52:1092-1093.

Ringed Seals were observed readily inhaling exhaust air from SCUBA divers under one year-old fast-ice in Lancaster Sound. The exhaust air had become trapped in depressions in the bottom of the ice and formed lens-shaped bubbles. Two seals were even observed 'stealing' air from the others by scooping it away with their foreflippers.

These observations are quite relevant in light of recent gas and oil development in the Arctic. It seems possible that seals might readily inhale any gas bubbles trapped under the ice. This hypothesis warrants testing since inhalation of natural gas could poison and/or kill the seals.

- Read, C.J. and S.E. Stephanson. 1976. Distribution and migration routes of marine mammals in the central arctic region. Fisheries and Marine Service Tech. Rept. No. 667. 13 pp.

This report contains general information regarding the distribution, relative abundance and migration routes of marine mammals in the central Arctic. The information was derived entirely from interviews with Inuit hunters (all over 50 years old) from Pelly Bay, Spence Bay and Gjoa Haven during the summers of 1971-1973. The authors consider that habitats and migration routes presented 'should not be interpreted as the only routes and habitats of the species concerned' but are 'representative of the major known areas of marine mammal activity'. [Some of the anecdotal information is significant and not available elsewhere, and other information is confirmed by recent systematic studies. However, some information presented differs markedly from results of recent aerial surveys of marine mammals in the area, particularly in the waters surrounding Prince of Wales and Somerset Islands (Finley 1976).]

Major Findings

The indicated migration routes and summering areas in the areas of concern to this bibliography (Wellington Channel, Barrow Strait, Western Lancaster Sound and Prince Regent Inlet) are similar to those described on the basis of recent scientific studies in the area. The descriptions of distribution and migration routes are briefly summarized below; references to other sources have been included where the information presented by Read and Stephanson deviates markedly from what is presently known from scientific studies in the area. These editorial comments are inserted in square brackets.

Beluga

Westward migration occurs through Lancaster Sound and includes (but is not necessarily restricted to) both coastlines. Populations disperse into Prince Regent Inlet, Peel Sound and Wellington Channel. The major

summering areas are reported to be Brentford Bay, Bellot Strait, and Peel Sound. [Neither Brentford Bay nor Bellot Strait are known to be important currently, and other areas now known to be important (cf. Finley 1976) are not identified as such by Read and Stephanson.] A clockwise migration occurs regularly around Prince of Wales Island. [This has not been documented in recent studies (cf. Finley and Johnston 1977). If Belugas do occur in coastal waters of western Prince of Wales Island, this must be a highly irregular event as recent LANDSAT imagery indicates that heavy ice in these waters would almost certainly prevent Belugas from occurring in the area.]

Narwhal

A westward migration proceeds along both coasts of Lancaster Sound. Some individuals turn north into Maxwell Bay, Devon Island; others turn S into Prince Regent Inlet and Peel Sound. Those entering Peel Sound circumnavigate Prince of Wales Island. [As discussed under Beluga, it is doubtful if the migration around S and W Prince of Wales Island is possible most years because of adverse ice conditions.] Those entering Prince Regent Inlet may summer near the E end of Bellot Strait or migrate S along the E coast of the Boothia Peninsula into the Gulf of Boothia.

[Recent surveys indicate that more Narwhals migrate into Admiralty Inlet than westward into Prince Regent Inlet and Barrow Strait. As for the Beluga, the apparent double migration route (along two coastlines) is likely an artifact of the fact that most opportunities for observation are from land during the open water season when the whales are moving through (cf. Finley 1976; Johnston *et al.* 1976b). The number of Narwhal reaching the vicinity of Prince of Wales Island is apparently small (e.g., few were observed in Peel Sound or Western Barrow Strait during intensive aerial surveys in 1974 and 1975--Finley 1976; Finley and Johnston 1977). The occurrence of a major summering area in Brentford Bay is not supported by recent studies although small numbers of Narwhal are known to occur there.]

Walrus

The migration extends west from Lancaster Sound; some turn southward into Prince Regent Inlet and others move N into Wellington Channel and W into Barrow Strait S of Cornwallis Island. Prince Leopold Island is listed as a summering area. [Recent surveys have failed to show this island to be important to Walrus.]

Bearded Seal

Primary summering areas are said to include Wellington Channel, Maxwell Bay (Devon Island), Prince Leopold Island, the east coast of Somerset Island (from Fury Point to Cape Clarence), and Creswell Bay. [Recent systematic surveys have failed to show concentrations in these areas.]

Ringed Seal

Summer concentrations of Ringed Seals are said to occur in Wellington Channel, Barrow Strait and Prince Regent Inlet (same locations as those listed for the Bearded Seal). [The occurrence of special concentrations in these areas has not been supported by recent surveys.]

Polar Bear

Hunters reported two main areas of bear distribution, (1) N Gulf of Boothia between Bernier Bay and Bellot Strait and (2) Victoria Strait between King William Island and Victoria Island. No concentrations of Polar Bears were indicated in Prince Regent Inlet, Barrow Strait or Wellington Channel. The nearest Polar Bear population exploited by the Inuit of the surveyed settlements was in northern Gulf of Boothia (SE of Bellot Strait).

Renewable Resources Consulting Services Ltd. 1977. Aerial surveys of marine mammals of Lancaster Sound, 1975-1976. Unpubl. Rept. to Norlands Petroleum Ltd. 110 p.

Scope

This report is a detailed analysis of the status, distribution and abundance of marine mammals (excluding Polar Bears) in eastern Lancaster Sound. It is based on systematic bimonthly aerial surveys in October 1975 (2 surveys) and from late February to late September 1976 (14 surveys). Incidental observations of marine mammals are included and discussed for western Lancaster Sound, east Barrow Strait, N Prince Regent Inlet, Admiralty Inlet, Navy Board Inlet and Eclipse Sound. Brief accounts of marine mammals observed during aerial surveys for seabirds are included (based on Johnson *et al.* 1976b).

Methods

Two surveys were conducted in October 1975; the survey route consisted of (a) 18 randomly-selected cross-sound lines running approximately North/South across eastern Barrow Strait and Lancaster Sound between the longitudes of Maxwell Bay and Philpots Island and (b) the coasts in this region. However, only one of the two surveys covered all of this route (lengths 2530 and 1001 km). In 1976 eight of the cross-sound lines in eastern Lancaster Sound were maintained and the coastline (or ice-edge, when present) was surveyed between the longitudes of W Croker Bay and Philpots Island. Some of the 14 surveys in 1976 were incomplete; survey lengths ranged from 349 to 1240 km and averaged 994 km. The 1976 study area was almost identical to that surveyed 22 times (once incompletely) during 1976 by Johnson *et al.* 1976a,b).

Surveys were flown in a Twin Otter aircraft at an altitude of 91 m; the transect width was 0.8 km (0.5 mi). Two observers, both in rear seats, were present. When possible, large concentrations of marine mammals were photographed to provide more accurate estimates.

An attempt has been made to relate the presence and/or movements of marine mammals to ice conditions in Lancaster Sound and adjacent waters; a 26-page section in the report describes ice conditions in detail. Fourteen maps based on data collected during the aerial surveys indicate (a) ice concentration and form, and (b) ice form and colour for each of the seven surveys conducted from early March to early June. More general information on ice conditions in the eastern Canadian arctic and W Greenland was derived from NOAA Satellite imagery.

● Schweinsburg, R. 1976. Polar Bears--research in and around Admiralty Inlet, July-August 1975. *In*: B. Kemper (ed.), Environmental baseline studies--1975. Strathcona Sound program. Preliminary Rept. 1976. Canadian Wildlife Service Report. 119 pp.

This report summarizes the findings of Polar Bear research conducted in Admiralty Inlet, Navy Board Inlet and southern Lancaster Sound between 23 July and 23 August 1975. The program was part of a study to determine the potential direct and indirect effects of developing the Nanisivik lead-zinc mine at Strathcona Sound. The report describes potential problems arising from the presence of the mine and presents the methods, results, discussion and conclusions of the 1975 studies. This is the most comprehensive report available on the Polar Bears of NW Baffin Island. Much of the information reported by Jonkel (1975) is considered by Schweinsburg.

The 1975 study area was surveyed by helicopter to locate Polar Bears; wherever possible the bears were captured. They were then ear-tagged, tattooed on the upper lip, weighed, measured, sexed, aged (by pulling a tooth) and marked on the rump with a black dye for later more distant identification. Information on the locations of bears sighted by other people in the study area was also incorporated in the report.

Because of the few bears resighted, the mark and recapture method for determining the population size was not successful in 1975. However, it was concluded on the basis of the large number of bears seen during the survey that a substantial number of Polar Bears do inhabit the area. It is likely that the entire N coast of Baffin Island and NW corner of Bylot Island is a summer sanctuary; yearly variations in Polar Bear use are caused by changing ice conditions. Schweinsburg states that the summer sanctuary along the N coast of Baffin Island is probably important to the bears and that human activities in this area should be controlled.

Schweinsburg also states that bears display no reluctance to swim during the summer and that contact with oil slicks could cause matting of

their fur and heat loss. Consequently, he states that the practice of ships pumping bilges into the sea must be stopped.

Maternity denning areas were not identified in this study.

- Sergeant, D.E. 1962. The biology and hunting of Beluga or White Whales in the Canadian Arctic. Fish Res. Bd. Canada., Arctic Unit, Ottawa Arc. No. 8. 13 pp.

This paper gives a short account of the biology, distribution and feeding habits of the Beluga, and outlines the status of the Beluga fishery in Canada. The emphasis is on the relatively well-known Hudson Bay population; most research north of the low Arctic is more recent. [The account is superseded by recent and more comprehensive works (Brodie 1971; Sergeant 1973; Sergeant and Brodie 1975).]

- Sergeant, D.E. 1965. Migrations of Harp Seals *Pagophilus groenlandicus* (Erxleben) in the northwest Atlantic. J. Fish. Res. Board Can. 22:433-464.

This paper considers 'all aspects of the annual cycle of the western Harp Seal...in so far as they relate to the animals' movements'. Most of the data presented regarding the recapture of young tagged on the breeding grounds of Newfoundland and Labrador are from W Greenland. Few references are made to the migration into Canadian Eastern Arctic waters.

Major Findings

Wintering areas and behaviour of North American Harp Seals are virtually unknown; presumably both breeders and non-breeders winter in the Maritime region from SE Labrador to Prince Edward Island. Breeding and pupping occur on pack ice during March in two areas off North America: (1) the Gulf of St. Lawrence and (2) E of Newfoundland. The young are abandoned by the females when they are 4 to 6 weeks old; the young then drift passively with the currents and finally initiate northward migration when 8 to 10 weeks old. The adults and immatures begin to migrate somewhat earlier (in April).

The migration northward early in the summer through Davis Strait and Baffin Bay is believed to be heaviest along the Greenland side where there is less drift ice. The immatures arrive in Greenland in June and July. A large contingent enters Lancaster Sound and Jones Sound in late summer. Sergeant does not document the western extent of penetration into Barrow Strait, Peel Sound and Prince Regent Inlet (see Finley 1976; Finley and Johnston 1977). Sergeant cites Tuck (1957) as recording a westward movement of 150,000 Harp Seals at Cape Hay, Bylot Island, between 26 June and 2 August 1957. [Greendale and Brousseau-Greendale (1977) cite Tuck as having observed 132,000 individuals; Tuck (1957) does not give an exact total in his manuscript but from the accompanying figure, it appears that 136,000 individuals were observed.]

Harp Seals may remain in Lancaster Sound until at least 2-4 October. An estimated 10,000 were observed E of Devon Island (at 76°01'N, 77°00'W) on 28 September 1963. The eastern arctic islands are probably not completely abandoned until November. Immatures have been taken from January to April on the W Greenland coast but it is thought that the majority return to winter in the Maritime region.

● Sergeant, D.E. 1973. Feeding, growth and productivity of northwest Atlantic Harp Seal (*Pagophilus groenlandicus*). J. Fish. Res. Board Can. 30:17-29.

This paper reviews existing knowledge of the feeding, growth and productivity of the population of Harp Seals that inhabits the NW Atlantic and eastern Arctic regions. Its value here is in identifying some of the major food items of Harp Seals that migrate into arctic waters.

The seals (primarily adults) that reach the eastern Arctic and west Greenland take Arctic Cod and various crustacea including euphausiids, mysids and the pelagic amphipod *Parathemisto libellula*. These conclusions are based on relatively few stomach samples.

There is a marked loss of weight in spring during the breeding season (especially by females); this weight loss is regained slowly during the summer. Interspecific competition with baleen whales and limited food resources off the east coast during the summer are considered likely causes of intense selection for the northward migration by Harp Seals.

- Sergeant, D.E. 1976. History and present status of populations of Harp and Hooded Seals. Biol. Conserv. 10:95-118.

This paper provides a holarctic review of the history of Harp and Hooded Seal populations. Information on the migration and breeding phenology of Harp Seals is taken from Sergeant (1965) and is not summarized here. A few relevant points are listed below.

The Harp Seal exploits a wide food spectrum. Capelin is the most important food item for older age classes except at high latitudes where it is replaced by Arctic Cod. In the Greenland Sea, under-ice amphipods are also important. The maximum feeding depth is about 250 m. The world population of Harp Seals formerly may have numbered 9 million; present populations are thought to be about 3 million.

A winter population of Hooded Seals (of unspecified size) has recently been rediscovered in Davis Strait at 64°N after 150 years.

- Sergeant, D.E. and P.F. Brodie. 1975. Identity, abundance and present status of populations of White Whales, *Delphinapterus leucas*, in North America. J. Fish. Res. Board Can. 32:1047-1054.

This review paper summarizes information on the numbers and distribution of Belugas in North America.

At least 30,000 Belugas occur in the North American Arctic. The Canadian population is at least 26,250 [not 26,500 as shown in Table 1]. The largest herds identified in Canada are about 10,000 animals in western

Hudson Bay, at least as many in Lancaster Sound, and at least 4000 summering in the Mackenzie River Delta. Smaller herds occur in Ungava Bay (1000 individuals), the St. Lawrence River (500) and in Cumberland Sound (750). The authors state that 'hunting in the Canadian arctic has decreased in the last decade from 1000 or more to about 500 annually and is clearly well below sustainable yields except at one locality, Cumberland Sound, where the local population of [Belugas] has never recovered from historic depletion. The species is most vulnerable when concentrated in river estuaries in summer, probably for reproduction.'

The authors report that within the present area of concern, concentrations of 1000+ have been observed at Cunningham Inlet, Elwin Bay and Creswell Bay, Somerset Island; at Maxwell Bay, S Devon Island; and at Fitzgerald Bay, NW Baffin Island.

The authors suggest, on the basis of ice conditions in Lancaster Sound in March and April 1974, that Belugas may winter in that area. [Examination of LANDSAT and NOAA imagery for the winters of 1973-74, 1974-75 and 1975-76 indicates that no areas remained open all winter. R.R.C.S. (1977) did not record Belugas in Lancaster Sound during aerial surveys in February 1975; the first Belugas appeared in the first half of March.]

● Silverman, H. 1977. Preliminary results of 1976 Narwhal (*Monodon monoceros*) research. Unpubl. Rept., McGill University, Montreal Quebec. 30 pp.

Silverman describes the behaviour and group relationships of Narwhals studied in undisturbed and hunt conditions in Eclipse Sound in 1976; she also presents and discusses those aspects of Narwhal migration recorded near Cape Hay, Bylot Island, from 21 June to 31 July 1976 (see Greendale and Brousseau-Greendale 1976). Narwhal movements and behaviours are related to changing ice conditions and hence potential food availability. Some acoustic monitoring was carried out but was not described. The goal of the study, which is expected to continue in subsequent years, is to identify reasons for the importance of Eclipse Sound and associated water bodies (particularly Navy Board Inlet and Admiralty Inlet).

The report is based on field observations made on the sea-ice and water; in addition, two hours were spent surveying by helicopter. Because the investigator spent a large part of her time accompanying the Inuit Narwhal hunt, undisturbed Narwhals were observed infrequently; much of the behaviour observed was reaction to motor boats and hunters. A major portion of the undisturbed Narwhal behaviour observed was from Cape Hay, and most information collected there concerned group sizes and age and sex composition.

The report presents preliminary information, and few conclusions were drawn:

1. At Cape Hay, the early migration waves of Narwhals occurred in late June and were composed primarily of tusked animals (presumably mostly males). The females with newborn calves composed the last major migration wave in late July.
2. An estimated 30% of the young-of-the-year Narwhals are born by the time the migration reaches Cape Hay. It thus appears that the fiords of northern Baffin Island are not sought out solely to provide the Narwhal with a prime birth sanctuary.
3. In Eclipse Sound, Narwhals may travel great distances (up to 20 km) under the fast-ice. During these times they use melting seal holes for breathing.

In summary, Lancaster Sound is an extremely important migration route for Narwhals. The numbers of Narwhals entering different areas should be proportional to the size and productivity of these areas. In fact, data indicate that more Narwhals enter Admiralty than Pond and Navy Board Inlets.

Smith, T.G. 1973a. Censusing and estimating the size of Ringed Seal populations. Fish. Res. Bd. Canada Tech. Rept. 427:1-18.

This paper outlines and evaluates methods used in aerial censusing and discusses the factors that should be considered before these figures are used in a final estimate of population size. Although the study areas (Home Bay, eastern Baffin Island; west coast of Victoria Island and Amundsen Gulf), were outside the immediate concern of this annotation, the implications of the study are of direct relevance to Ringed Seal populations in the vicinity of Lancaster Sound.

Major Findings

Smith concurs with McLaren (1958) in concluding that large differences in seal densities appear to be associated with differences in coastal complexity--higher densities occur in complex coastal areas. However Smith states that McLaren appears to have grossly overestimated densities in coastal areas by extrapolation from a small area of fast ice late in the season. Mean densities per square nautical mile in complex coastal areas on the east coast of Baffin Island were 8.8 for fiords, 6.5 around islands and 5.0 in offshore ice. In contrast, densities of 2.36 to 4.58 were recorded on ice at various distances from the coastline of western Victoria Island. Smith also noted that ice conditions (stability, pressuring, snow cover, etc.) may greatly affect seal densities in some areas.

It is suggested that in order to calculate population densities, the densities derived from aerial survey techniques must be altered to account for inaccuracies of the survey method (failure to detect a portion of the seals on the ice as well as those under the ice, effects of survey height) and for variables inherent in the seal population (behaviour in relation to time of year, ice break-up, time of day, wind speed, cloud cover). Hence, absolute population densities are not presented.

- Smith, T.G. 1973b. Population dynamics of the Ringed Seal in the Canadian eastern arctic. Fish. Res. Bd. Canada Bull. 181:1-55.

Although this study is based largely on material from outside the Lancaster Sound area (mainly Home Bay and Cumberland Sound, SE Baffin Island), the findings are of interest to this bibliography. The study is based on the ageing of 10,856 seals and reproductive tract analysis of 1145 seals in the highly exploited population of the Cumberland Sound area and in the relatively unexploited population of adjacent Home Bay area. In addition, aerial surveys were flown over 1192 square nautical miles of fast-ice.

Major Findings

Three types of fast-ice were surveyed: (1) ice in deep fiords, (2) areas at the mouths of fiords and around islands, and (3) transects of width one mile from the coast to the floe edge (i.e., off-shore fast-ice); the resultant densities were 8.83, 6.53 and 5.02 seals/nautical sq mi. Subadults generally dispersed offshore in winter while breeding adults occupied coastal fast-ice.

With regard to population biology, it was stated that 'males mature sexually at age 7 and 40% of 4-year-old females are mature. There is an 81-day delayed implantation period and an active gestation of 270 days.' Vital statistics and tables for the life populations are provided. The best estimate for maximum sustainable yield was 7.2% of the resident stock.

- Smith, T.G. 1975. The breeding habitat of the Ringed Seal (*Phoca hispida*). The birth lair and associated structures. Can. J. Zool. 53:1297-1305.

This paper is based on a study of subnivean birth lairs of Ringed Seals in Amundsen Gulf and Prince Albert Sound in 1971 to 1974. The results, while based on field work outside Lancaster Sound, provide information on seal distribution in relation to habitat types. One of the findings was

that birth lairs were more abundant in inshore ice than in offshore ice; this supports previous studies that have indicated the importance of the nearshore fast-ice for the breeding segment of the Ringed Seal population (McLaren 1958).

● Smith, T.G., D. Taylor and Hahgagiak. 1976. Breeding habitat and population surveys of seals in the Viscount Melville Sound, Barrow Strait and Peel Sound areas. Interim Rept. to Arctic Islands Pipeline Project, Environment Canada. 31 pp.

This report summarizes the results of seal studies in Viscount Melville Sound, Barrow Strait and Peel Sound in 1975. 'The present study attempts to assess the fast ice as breeding habitat for the ringed seal and derive population estimates for the areas under consideration as marine crossing routes' by the Polar Gas pipeline.

The aspects of this study that are of most relevance to this annotation were accomplished using two methods:

1. Birth Lair Survey. Between 8 May and 2 June, 50 preselected sites were searched with a dog for subnivean lairs of Ringed Seals. Each site was searched for 0.5 hours and an index of number of lairs/half hour period was established for each site.
2. Fixed-wing Survey. A total of 49 hours of fixed-wing surveys were flown between 16 and 28 June. The survey methods were similar to those described and used by Finley (1976); hence the results are comparable to those of Finley.

Major Findings

1. Birth Lair Survey. Standard searches yielded an average of one lair or breathing hole every 12.7 minutes and one birth lair every 38.7 minutes. The highest mean density of lairs

found in any area was in the Aston Bay area; four sites yielded a mean of 4.0 subnivean structures per half hour search. The second highest mean density occurred in Barrow Strait south of Cornwallis Island (mean of 3.25 structures per half hour). The highest single density of subnivean structures (11 per half hour) was found at a site nearest the floe edge in E Barrow Strait. Sites in W Barrow Strait between Bathurst and Prince of Wales Islands yielded an average of 2.6 structures per half hour.

2. Fixed-wing Aerial Survey. The highest densities of hauled-out seals occurred in the Peel Sound area in the vicinity of Aston Bay, Somerset Island, and near the northeastern tip of Russell Island. There was a marked decrease in the densities of seals westward into Viscount Melville Sound. These findings are in agreement with those of Finley *et al.* (1974) and Finley (1976).

● Stephansson, S. 1976. Marine mammal resources of the Admiralty Inlet--Navy Board Inlet area. *In*: B. Kemper (ed.), Environmental Baseline studies--1975. Strathcona Sound Program. Preliminary Rept., Canadian Wildlife Service. 119 pp.

The report on marine mammal surveys conducted as part of the Strathcona Sound program in 1974 and 1975 was not included in Kemper (1976). However, a brief report on the results of these surveys is included in the summary at the beginning of the volume.

Marine mammal surveys were conducted in Admiralty Inlet, Navy Board Inlet and Lancaster Sound from 23 July to 20 August 1975.

It is suggested that these areas are very important to Narwhals; the total population was estimated to be 8,945 individuals. There is, however, no indication of the methods employed to arrive at this figure. The species apparently calves in the area.

Three Bowhead Whales were observed near Peter Richards Inlet in Admiralty Inlet.

Ringed Seals were numerous and permanent residents.

An estimated 4000 adult Harp Seals were present in Admiralty Inlet during the ice-free period. A herd of 300 immature Harp Seals was seen off the entrance to Navy Board Inlet in early August.

● Stirling, I. 1974. Midsummer observations on the behaviour of wild Polar Bears (*Ursus maritimus*). Can. J. Zool. 52:1191-1198.

Stirling describes the behaviour of Polar Bears in Radstock Bay, on SW Devon Island from 24 July to 8 August 1973. During the observation period (602.7 hours) a total of five Ringed Seals were caught by Polar Bears; this represented an average of one kill every five bear days. This apparent low success rate was attributed to the abundance of natural holes through which the seals could surface to avoid being caught.

This paper provides no estimates of numbers of bears present nor does it given any information on kinds of ice upon which bears prefer to hunt.

● Stirling, I., R.E. Schweinsburg and H.P. Kiliaan. 1976. Polar Bear research along the proposed Arctic Islands Gas Pipeline route. Progress Rept., Dept. of Environment. 32 pp.

This report gives a preliminary summary of the data available on the distribution and movements of tagged bears, locations of maternity dens and summer sanctuaries and age structure of bears captured or killed in the central Arctic islands. These topics are discussed in the light of new research by the writers and through a review and synthesis of published and unpublished information from the area. The new information was obtained from observations of marked and unmarked Polar Bears in the central High Arctic. Denning areas were located during helicopter surveys.

Major Findings

No conclusions are presented relating to population size or movements, although a map showing movements of tagged bears is presented; both short and long distance movements are apparent. Polar Bears were much more abundant in Prince Regent Inlet than in Peel Sound during spring and summer 1975.

Between freeze-up and break-up Polar Bears are confined to areas favourable to Ringed Seals (e.g., floe edges, refrozen leads, ice in intermittent restricted motion, pressure ridges). As the sea ice breaks-up the bears retreat to the last areas of fast-ice in bays and fiords. During the ice-free season Polar Bears remain on land, often at the heads of bays or on ice caps. In general, summer sanctuaries are poorly known; they include Radstock Bay, S Devon Island and might include Creswell Bay, Brentford Bay and at least parts of Prince of Wales Island, Cornwallis Island and Bathurst Island. [None of these areas have been adequately surveyed for summer sanctuaries.]

Information on denning areas is fragmentary and not adequate to assess implications of industrial activity. Known or suspected maternity denning areas include Russell Island, Lowther Island, southern Bathurst Island, southwest Cornwallis Island, Griffith Island, NW Prince of Wales Island, N and E Somerset Island and Young Island.

Seven Inuit communities either lie within the Polar Gas study area or hunt bears from subpopulations that are partially within it. Quotas and kill estimates are provided for these settlements for the eight seasons from 1967-68 to 1974-75 (Table a). The authors expect that the total kill was considerably higher than that reported. The monetary return on this resource was estimated to be half a million dollars for the eight-year period.

[The reader is cautioned that the summary of annual ice conditions (p. 7) is erroneous].

Table a.
Quota and harvests of polar bears from selected Inuit settlements.¹

Settlement	YEAR															
	67-68	68-69		69-70		70-71		71-72		72-73		73-74		74-75		
	Q ²	K ²	Q	K	Q	K	Q	K	Q	K	Q	K	Q	K	Q	K
Cambridge Bay	10 - 10	10 - 8	10 - 10	10 - 10	10 - 10	10 - 9	10 - 11	10 - 10	14 - 12	14 - 14						
Spence Bay	23 - u ²	23 - 23	23 - 25	22 - 21	22 - 25	22 - 24	22 - 23	22 - 22	22 - 22	22 - 22						
Pelly Bay	9 - u	11 - 7	11 - 6	10 - 10	10 - 10	10 - 10	10 - 10	10 - 10	10 - 10	10 - 10						
Gjoa Haven	8 - u	10 - 5	10 - u	8 - 6	8 - 8	8 - 8	9 - 9	9 - 9								
Resolute Bay	50 - 52	40 - 47	40 - u	34 - 33	34 - 33	34 - 34	34 - 35									
Arctic Bay	10 - u	12 - 7	12 - 12	12 - 12	12 - 12	12 - 12	12 - 13									
Grise Fiord	17 - u	27 - 17	27 - 23	27 - 27	27 - 27	33 - 33	33 - 33	33 - 29								
	127 - 62	133 - 114	133 - 76	123 - 118	123 - 126	129 - 131	134 - 135	88 - 84								

¹ From Sterling *et al.* 1976.

² Q = quota; K = reported kill; u = unknown.

- Tuck, L.M. 1957. Wildlife investigations in the Cape Hay region, Lancaster Sound, 1957. Unpubl. Canadian Wildlife Service Report No. 760. 39 pp + plates.

This report consists of the account of bird and mammal observations near Cape Hay, Bylot Island, from 11 June to 28 August 1957. The observations of birds have been published in more detail in Tuck and Lemieux (1959) and Tuck (1960). The marine mammal observations were repeated at the same location in 1976 by Greendale and Brousseau-Greendale (1976).

The main limitation of the findings is the lack of documentation of the intensity of observation. The periods of observation and the periods (if any) when observations were impossible due to inclement weather are not indicated. Since the author was simultaneously conducting a major study of Thick-billed Murres at Cape Hay, it seems probable that there are many gaps in the observation periods.

Significant sightings of marine mammals included observation of a westward migration of about 136,000 Harp Seals (total based on Tuck's Figure 8) and 6000 Narwhals. Three Bowhead Whales were observed together on 4 July. Belugas were observed twice: a group of 30-40 on 26 June, and a single individual on 4 July. Single Harbour Seals were observed on four dates. Tuck stated that the Bearded Seal was 'rather common' but did not give details of the numbers seen.

Walrus were observed frequently; the largest group was of 50-60 travelling westward on 8 July. On 15 July a group of 15 individuals was seen hauled-out on ice-pans near the Wollaston Islands; only occasional animals were seen in that area after that date.

● Vibe, C. 1950. The marine mammals and the marine fauna in the Thule District (Northwest Greenland) with observations on ice conditions in 1939-1941. Medd. Grønland 150:1-115.

Vibe provides detailed information on the life histories of marine mammals in the Thule District, Greenland. The report is based on collections and observations of marine mammals in the area, most obtained between August 1939 and April 1940. The studies were conducted entirely in areas outside the Lancaster Sound region; however, observations of the diets of marine mammals in the Thule area are presumably relevant to Lancaster Sound. For many marine mammals, the Thule District is the area nearest to Lancaster Sound where major food studies have been done. This report is also significant because it is one of the few references based (in part) on winter work.

Major Findings

Walrus

It is suggested that the maximum foraging depth is 80 metres. The main food items were *Cardium* [*Serripes*] *groenlandicum*, *Mya truncata* and *Saxicava* [*Hiatella*] *arctica*. [All three species occur throughout the Canadian Arctic Islands.]

Bearded Seal

• This species is primarily a benthic feeder but has a very diversified diet. The major food items are molluscs, with a preference for *Buccinum*. In areas where the Bearded Seal is apparently unable to feed on the bottom (>300 metres deep) the food consists almost entirely of Arctic Cod (*Boreogadus saida*).

Harp Seal

The one stomach examined contained only Arctic Cod.

Ringed Seal

The diet is highly variable. Relatively few stomachs were examined, but it was concluded that Arctic Cod was the main food item where the seal forages pelagically, while amphipods and decapods were the main food items near the coast. [On SW Baffin Island, McLaren (1958) found that Arctic Cod were important in the diet of those animals that fed near the coast; these seals also feed extensively on crustaceans (primarily *Parathemisto libellula* and *Mysis oculata*). In offshore areas the diet was almost exclusively *Parathemisto*.]

ORNITHOLOGY AND MARINE MAMMALOGY

This section includes references that contain relevant information on birds and mammals in the study area. When these references are considered significant for either or both birds and mammals, this has been noted in the introductory remarks of the 'Ornithology' or 'Marine Mammalogy' sections.

Several references relate the bird and marine mammal resources to their utilization by the Inuit (i.e., Villiers 1968; Bissett 1967a, 1967b, 1967c; Usher 1975; Milton Freeman Research Ltd. 1976).

- Alliston, W.G. 1976. A summary of research on birds, marine mammals and marine ecology in the Districts of Franklin and Keewatin, N.W.T., 1974 and 1975. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 90 pp.

This report summarizes research on birds, mammals and marine ecology that was conducted by LGL Ltd. for Polar Gas Project during 1974 and 1975. The results summarized are from Finley *et al.* (1974) and Finley (1976) for marine mammals, Davis *et al.* (1974) and Alliston *et al.* (1976) for birds, and Davis *et al.* (1975) for birds and mammals. The reader is referred to the annotations of the original reports for summaries of the main findings.

- Bissett, D. 1967a. Resolute. An area economic survey. A.E.S.R. 67/1. Dept. Indian Affairs and Northern Development. Ottawa. 175 pp.

This volume discusses the renewable resource base of the Resolute Bay area in relation to Inuit exploitation. This information has been gathered through interviews with the Inuit, examination of fur and skin sales at the local Hudson's Bay Co. and Co-op, through scientific studies of wildlife in the area and by aerial surveys for ungulates on Bathurst and Cornwallis Islands.

Major Findings

Up to 476 ducks per year were taken between 1958-59 and 1965-66; the average was 125 individuals per year. The main species taken were Common Eider and Oldsquaw, both of which were hunted only incidentally during expeditions to hunt marine mammals. Geese were taken only rarely during this same period.

The principal areas for hunting of Polar Bears include Barrow Strait (Garrett, Lowther, Griffith and Young Islands) and Wellington Channel (Cape Dungeness to Cape Eardly William on South Devon Island). In the years prior to 1968, the kill of Polar Bears by Resolute Inuit far exceeded that in other hunting areas in the Canadian Arctic. An annual quota of 40 bears was introduced at Resolute in 1967-68; the average taken per year during the preceeding three winters was 68 individuals.

The Ringed Seal is common in marine areas and is taken over a very wide area including virtually all of Barrow Strait and parts of Wellington Channel. Ringed Seals are hunted most intensively in the near vicinity of Resolute along the south shore of Cornwallis Island and in Resolute Passage. Bearded Seals are locally distributed; Allen Bay, west of Resolute, is a major hunting area. Harp Seals are a minor resource item.

Walruses are no longer of great importance to the Inuit of Resolute due to the decline during the 1950's of numbers at the former major haul-out locations in Allen Bay. The average annual kill was 16.1 individuals between 1958-59 and 1965-66; the extremes were eight in 1960-61 and 37 in 1958-59. The Walruses are reported to arrive in E Barrow Strait during late July; they migrate into Wellington Channel and W to McDougall Sound during August and leave the area by retracing their spring migration path in September. [Finley (1976) suggests that a portion of the population winters in Queen's

Channel and he found that Walruses arrive in E Barrow Strait in June when ice conditions permit.]

The Inuit have not observed Bowhead Whales or Killer Whales in the area [Finley (1976) summarizes sightings of Bowheads by other sources]. Narwhals are rarely hunted; only four are known to have been taken by hunters from Resolute Bay. Belugas are taken regularly, though in smaller numbers in the four years preceeding 1967; an annual average of 50.6 individuals have been taken between 1958-59 and 1966-67 with extremes of 98 in 1961-62 and three in 1964-65 and 1965-66. The smaller number taken in more recent years has been attributed to smaller numbers near the settlement.

Both Narwhals and Belugas migrate into Barrow Strait from Lancaster Sound during June and penetrate into Prince Regent Inlet and Peel Sound; Narwhals also enter Admiralty Inlet. Small numbers of Belugas may reach McDougall Sound.

● Bissett, D. 1967b. Northern Baffin Island. An area economic survey. Vol. 1. A.E.S.R. 67/1. Dept. Indian Affairs and Northern Development. 209 pp.

This study was one of a series of studies designed to determine the basis for local economic and social progress in the northern Baffin Island region. Among the main objectives were to assess renewable resources and their ability to sustain the local population, and to determine the extent and efficiency of utilization of these resources.

The report is already seriously outdated. In 1967, when the report was completed, Narwhal tusks were not exported except occasionally in the form of arts and crafts and Polar Bear hides were less valuable than at present. While some indication of the use of marine mammals is given, little quantitative information is available on what proportion of the natural resources are used locally; some indication of the numbers of skins and furs exported via the Hudson's Bay Co. is given.

Major Findings

Fur trading is a major source of income for the Inuit in both Pond Inlet and Arctic Bay. Few statistics are given to indicate which species are most important but it appears that Ringed Seals make up a significant portion of all hides traded; it is likely that more seal skins than fox skins are traded, but the value of the fox furs is considerably more than the value of the seal skins. Bearded Seals were a minor item. Polar Bears were important in terms of cash. A total of 106 bears were taken between the winter of 1931/32 and that of 1948/49 at Arctic Bay (average, 5.9 skins/year); the minimum was 0 in 1940/41 and 1941/42 and the maximum was 36 in 1933/34. At Pond Inlet, 42 bears were taken between 1936/37 and 1947/48 (average, 3.5 skins/year); the minimum was 0 during 6 years and the maximum was 29 in 1947/48. [The 1976 harvest quotas for Arctic Bay and Pond Inlet were 100 Narwhals at each settlement, 12 Polar Bears at Arctic Bay and 14 Polar Bears at Pond Inlet.]

- Bissett, D. 1967c. Northern Baffin Island. An area economic survey. Vol. 2. A.E.S.R. 67/1. 131 pp.

This volume serves as a supplement to volume 1 of the area economic survey of Northern Baffin Island; it deals specifically with the subsistence economy of the Inuit at Arctic Bay and Pond Inlet. The material was gathered during hunting trips and interviews with hunters and trappers from each settlement.

Major Findings

Information on fur and sealskin harvests at Pond Inlet and Arctic Bay is contained in Usher (1975), and hence is not presented here. This annotation summarizes the relevant information on major hunting areas and the importance of the marine mammals to the domestic needs and economic gains of the Inuit of Pond Inlet and Arctic Bay.

Marine Mammals

Beluga

Belugas are of minor importance in the local economies of Pond Inlet and Arctic Bay.

Narwhal

Narwhals move into the area at ice break-up in late June; an outward movement occurs at freeze-up. Summer movements include all of Navy Board Inlet, Pond Inlet, Eclipse Sound, Admiralty Inlet, Coutts Inlet and Buchan Gulf; Narwhals in the latter two areas are not presently utilized.

Compared to Pond Inlet, Narwhals are of less importance to the Inuit of Arctic Bay because the catch is more variable due to ice conditions and the movements of herds.

Killer Whale

Killer Whales arrive in Pond Inlet and Eclipse Sound in late July and August.

Bowhead Whale

Most sightings of Bowhead Whales are from Navy Board Inlet and E Pond Inlet.

Polar Bear

The most important hunting area for Polar Bears used by Pond Inlet Inuit is the floe-edge in Baffin Bay from Cape Walter Bathurst on Bylot Island to Buchan Gulf on N E Baffin Island. Most Arctic Bay Inuit hunt along the west coast of Prince Regent Inlet from the Gulf of Boothia to Lancaster Sound. The best hunting period is the spring (mainly March and April).

Walrus

A Walrus haul-out site is reported at Wollaston Island. Walruses also

occur off Button Point, along the N and E coasts of Bylot Island; the species is infrequently found in Admiralty Inlet. Walruses are taken only opportunistically by Inuit.

Bearded Seal

The Bearded Seal is of secondary importance to the Inuit. The species moves into bays, inlets and fiords at ice break-up and most leave again in late September and October. Very few remain at breathing holes during the winter. Bearded Seals are hunted most extensively in southern Navy Board Inlet, W and S Eclipse Sound and E Pond Inlet. In the Arctic Bay area, the favoured hunting areas are S Lancaster Sound off Cape Crauford and the southern 1/3 of Admiralty Inlet.

Harbour Seal

This species occurs in small numbers in the Pond Inlet area.

Ringed Seal

The species is a staple food resource and trade item for Inuit at Arctic Bay and Pond Inlet. Ringed Seals are hunted at holes from late October until ice break-up in April; some seal netting is also done by the Inuit of Pond Inlet. Seal hunting at holes is carried out along refrozen cracks which open predictably and regularly. Most seal netting by Inuit from Pond Inlet occurs along SE Eclipse Sound but scattered netting areas occur from the mouth of Navy Board Inlet to the mouth of Pond Inlet. Hunting of young seals at birth lairs occurs from late March to early May.

Basking seals are hunted during the spring haul-out period and Ringed Seals are shot opportunistically during the open water season.

In general, the major hunting zones used by Inuit from Pond Inlet include all of Pond Inlet, SE and NW Eclipse Sound and local areas throughout most of Navy Board Inlet; the Inuit from Arctic Bay use the northern 2/3 of Admiralty Inlet.

Bissett summarizes McLaren's (1958) estimates of 55,300 Ringed Seals in the Pond Inlet area from Navy Board Inlet to Cape Adair and 43,900 Ringed Seals in Admiralty Inlet from Cape Crauford and Cape Charles Yorke to Bell Bay and Berlinguet Inlet. Citing McLaren's maximum sustained yield of 8%, Bissett states that harvest may be approaching maximum sustainable yield. [Smith (1973) states that McLaren's estimates are 'grossly overestimated'; see annotation for details.]

Harp Seal

Harp Seals follow the floe edges at break-up; few remain by October. Due to the seasonal availability and more easily taken Ringed Seal, the Harp Seal is not an important resource.

Hooded Seal

This species is taken only rarely in Navy Board Inlet.

Birds

Birds form a relatively minor food item for Inuit at both Pond Inlet and to an even smaller extent at Arctic Bay. Eggs and adult and young Snow Geese are utilized from the concentrations on SW Bylot Island; egg-gathering from the Thick-billed Murre colony at Cape Graham Moore occurs in late June and early July.

● Canadian Wildlife Service. 1972. Arctic ecology map series (2nd edition). Environment Canada, Ottawa. 324 pp.

The report and accompanying maps identify and document areas of the Canadian Arctic that are critical to the survival of arctic wildlife. Through interviews and a literature search, the volume attempts to bring together all that is known about habitat utilization by important populations of mammals, birds and anadromous fishes in the Canadian Arctic. A prime objective of the study was to provide a planning tool that government and industry can use in the development of the north.

Areas important to wildlife have been mapped on 1:250,000 scale maps. Two maps, Lancaster Sound and Eclipse Sound, include all areas of direct interest to this annotated bibliography. The important areas are labelled on each map by means of symbols and abbreviations; the supporting details and sources of information are included in the accompanying volume of text.

[Due to the nature and objectives of the study and the relatively small amount of detailed information available from a very large area, the maps are necessarily general. The supporting text is often brief, often lacks quantitative information, and includes information of highly variable quality. For example, some references to 'important' seabird colonies do not specify which species are present. Subsequent studies have added a great deal to what was known in 1970 when the report was prepared; many more areas critical to the survival of major arctic animal populations have since been identified. Nettleship and Smith (1975) provide more comprehensive and recent descriptions of some of the biologically important locations within the area of concern.

Many references are also erroneous, misleading or out of date (e.g., murre colony on Griffith Island, Walrus haul-out site on Wollaston Islands). Certain references available at the time appear to have been completely overlooked. For example, Tuck's estimate of 136,000 Harp Seals migrating along the north coast of Bylot Island in 1957 is nowhere cited. Another gap, perhaps attributable to lack of research before 1970, is the failure to identify certain recurring ice-edges important to many species of seabirds and sea mammals (especially Polar Bears) during the spring and early summer.]

The following is a list of areas identified by C.W.S. (1972) as important to wildlife; only sites in the area of concern to the present bibliography are considered. Where more recent information is available for these areas, this has been included in square brackets.

LocationSignificance

Philpots Island

Breeding area for Brant and Greater Snow Geese.

Cape Hay,
Bylot Island

Contains 1,000,000 breeding seabirds; Thick-billed Murres represent 400,000 pairs. [Brown *et al.* (1975) indicate that there are 400,000 pairs of murres and 50,000 pairs of Black-legged Kittiwakes; however, they state that the number of murres presently using the cliffs is now considerably lower than Tuck's estimate.]

Baffin Bay, NE of
Bylot Island

Important migration route for Narwhals and Harp Seals.

Cape Walter Bathurst,
Bylot Island

Colonies of Thick-billed Murre and Black-legged Kittiwake. [Brown *et al.* (1975) make no reference to this location for either species; this may be a mistaken reference to Cape Graham Moore.]

SW coastal plain, Bylot
Island

20,000 of the 75,000 Greater Snow Geese in N. America nest here. [This is apparently an updated estimate of the figure of 15,000 given by Lemieux (1959).]

Cape Coutts, NE Baffin
Island

Polar Bear denning and hunting area.

Nova Zembla Island,
NE Baffin Island

Northern Fulmar colony. [Brown *et al.* (1975) do not list this as a colony location but show three adjacent colonies totalling 25,000 pairs in Buchan Gulf about 50 km SE.]

Croker Bay, SE
Devon Island

Polar Bear area.

E Croker Bay to E of Dundas Harbour, SE Devon Island 'Thousands' of Oldsquaws on 29 May 1968.

NE Lancaster Sound

Migration route for Walruses and Narwhals in July and August. [Surveys in 1976 indicate that the area is also important for Belugas; they occur in this area at least from March to October (Johnson *et al.* 1976b, R.R.C.S. 1977).]

SE Lancaster Sound

Migration route for Harp Seals. [Tuck (1957) estimated 136,000 passing west during June and July 1957.]

Wollaston Islands

Walrus haul-out site. [Reports of the numbers of animals using this area vary considerably. R.R.C.S. (1977) and Johnson *et al.* 1976b) found small numbers (maximum of 30 individuals) in the area in 1976. Historical references to this area have reported up to 200 to 300 individuals (Miller 1955); these have almost invariably been second-hand accounts received from Inuit at Pond Inlet.]

Navy Board Inlet

Narwhal concentrations in late July.

Eclipse Sound

Concentration area for Narwhals and Harp Seals.

Koluktoo Bay,
N Baffin Island

Calving area for 'several thousand' Narwhal.

Coastal Admiralty Inlet
from Baillarge Bay to
Elwin Inlet

Major fulmar colony. [Brown *et al.* (1975) estimate 25,000 pairs.]

Ice-edge at N end of
Prince Regent Inlet

Important area for Walrus and Polar Bears.

Cape Clarence, NE Somerset
Island, and Prince Leopold
Island

Major seabird colony; 150,000 Northern Fulmars, 3000 Glaucous Gulls, 180,000 Black-legged Kittiwakes, 350,000 Thick-billed Murres, and 4000 Black Guillemots (Barry 1958). [The most recent but preliminary estimates for Prince Leopold Island are for 1976: 60,000 fulmars, 58,000 kittiwakes, 140,000 murres, 4000+ guillemots (Nettleship and Gaston 1977). Apart from scattered pairs of guillemots, no seabirds nested at Cape Clarence in 1974 (Davis *et al.* 1974), 1975 (Alliston *et al.* 1976) or 1976 (Nettleship and Gaston 1977).]

Aston Bay, NW Somerset
Island

Beluga concentration area. [Not important to Belugas in 1974 or 1975; high densities of Ringed Seals occur here prior to break-up (Finley 1976).]

NW Somerset Island
(N end of Peel Sound)

Polar Bears concentrate in an area of open water regularly present during the winter; in summer females with cubs occur in the area. [The regularity of this open water in winter is unknown].

Limestone Island,
NW Somerset Island

A breeding area for Northern Fulmars, Black-legged Kittiwakes, Thick-billed Murres and Black Guillemots. [Brown *et al.* (1975) do not list this as a colony location for fulmars, kittiwakes or murres. During 1974 and 1975 only small numbers of Black Guillemots (75 + pairs) and Glaucous Gulls nested on the Island (Alliston *et al.* 1976).]

Cunningham Inlet, N
Somerset Island

A concentration area for Belugas; up to 2000 individuals (plus young-of-the-year) occur during summer. [Recent data in Hay and McClung 1974; Finley 1976]

East Barrow Strait*

Dispersal route for Polar Bears from denning areas on SW Devon Island.

SW Devon Island and
adjacent waters from near
Beechey Island to Cape
Bullen; Wellington Channel
ice-edge; extreme SE
Cornwallis Island*

Polar Bear denning and feeding area.

N Prince Regent Inlet

Important for Bowhead Whales.

Batty Bay and Elwin
Bay, E Somerset Island

An estimated 75 Walruses summer in these bays. [There is apparently no evidence indicating that these areas are now used by significant numbers of Walrus (Finley *et al.* 1974; Finley 1976).]

Lowlands N of
Creswell Bay

The Creswell Bay lowlands and an inland area about 70 miles NW of the bay have a total nesting population of $800 \pm$ Snow Geese. [In the Creswell River lowlands alone, up to 2700 were present in 1974 but few pairs nested; in 1975, 504 adults and 737 young in family groups as well as about 1000 other moulting geese used the area (Alliston *et al.* 1976).]

Creswell Bay

Concentration areas for Narwhals, Ringed Seals, Belugas and Polar Bears; the 'few hundred' Beluga which inhabit this area are 'considered a breeding population'. [Creswell Bay is likely the single most important summer concentration area for Belugas in the entire Barrow Strait--Lancaster Sound area. Peak numbers in the bay were 3463 in 1974 and 3897 in 1975; the bay is believed to be an important calving area (Finley 1976). Creswell Bay is important for several other species of birds and mammals (see account of Alliston *et al.* 1976 and Finley 1976).]

Barrow Strait S of Cornwallis Island *

Migration route for Harp Seals, Walruses, Belugas and occasionally Narwhals.

Griffith Island

Thick-billed Murre colony. [Brown *et al.* (1975) do not list this as a colony location. Murres were concentrated along the ice-edge near Griffith Island during June 1974 and July 1975 but none nested on the island (Alliston *et al.* 1976).]

In summary, this was a useful first-step approach to identifying important areas for arctic wildlife. It summarized many published and unpublished data and suppositions from workers in the area. However, this map series is now out-of-date for the areas of concern to this bibliography.

* Recent studies of these important areas include Davis *et al.* (1974, 1975), Finley *et al.* (1974), Alliston *et al.* (1976), Finley (1976), Nettleship (1976), Bain *et al.* (1977), Bradstreet and Finley (1977), Finley and Bradstreet (1977) and Nettleship and Gaston (1977).

- Davis, R.A., K. Finley, M. Bradstreet, C. Holdsworth and M. McLaren. 1975. Studies of the numbers and distribution of birds and mammals in the Canadian Arctic--1974: a supplement. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. 205 pp.

This volume is a supplement to Davis *et al.* (1974) and Finley *et al.* (1974). With respect to birds, this volume provides details of terrestrial grounds-transect surveys to determine habitat preferences and population indices. These are beyond the scope of this bibliography and hence are not further discussed here. The report also evaluates the aerial and ground survey techniques which were employed. Site-specific information on one marine area, Creswell Bay, is discussed in detail. These results and results from more detailed studies conducted at Creswell Bay in 1975 are described in the review of Alliston *et al.* (1976).

- Duvall, A.J. and C.O. Handley. 1946. Report of a wildlife reconnaissance of the Eastern Canadian Arctic. Special Report, United States Department of the Interior, Fish and Wildlife Service, manuscript report. 138 pp. (Also Canadian Wildlife Service No. 239. 138 pp).
- Duvall, A.J. and C.O. Handley. 1948. Second wildlife reconnaissance of the Eastern Canadian Arctic. Special Report, United States Department of the Interior, Fish and Wildlife Service, manuscript report. 168 pp. (Also Canadian Wildlife Service No. 9. 168 pp.).

These two volumes present the observations of mammals and birds made at various locations throughout the eastern Canadian Arctic during an expedition of the U.S. Navy from about 13 July to 10 September 1946 (first reconnaissance) and 29 July to 20 September 1947 (second reconnaissance). During both years, the primary objective of the study was to investigate the status of migratory waterfowl on Melville Island but due to adverse ice and weather conditions and changes in the ship's itineraries, the brief visits made to that island were insufficient to provide much information. However, field trips of up to several days duration were made along sections of the coasts of Melville, Bathurst, Cornwallis, Somerset, Devon, Baffin, Ellesmere and several smaller adjacent islands; visits were also made to northwest Greenland.

Each account consists of a brief description of geology and physiography (the 1946 volume contains maps of each area), followed by an account of each species of bird and mammal observed in the area. The reports, therefore, consist largely of anecdotal observations of wildlife; no systematic surveys were undertaken. However, details on the numbers of birds and mammals seen in each area provide useful information on the relative abundance of each species.

The primary value of these two volumes is the large amount of information given regarding the distribution of birds and mammals in the eastern Arctic; in fact many of the areas visited in 1946 and 1947 have not since been investigated by naturalists.

Major Findings

Only the most significant observations of birds and mammals are summarized here.

Birds

Northern Fulmars were reportedly 'extremely abundant' in Lancaster Sound and Dundas Harbour; on 27 July and 13 August 1947, 'flights running into tens of thousands were observed'.

Significant quantitative information is presented concerning eider migrations through Lancaster Sound. A mass eastward movement of thousands of female eiders along the N coast of Baffin Island was recorded on 27 August 1946. An eastward migration of 10,000 + eiders near Cape Hay, Bylot Island, on the same date was presumably part of the same movement.

In 1946, 32 Ivory Gulls were observed near Byam Martin Island on 31 August. On 5 September, 16 individuals were seen near Griffith Island. On 6 September, 8 were observed off Eden Point, Devon Island. On the same date about 100 Ivory Gulls were seen in Wellington Channel.

The second report provides the first information on the importance of Resolute Bay, Cornwallis Island, to Ivory Gulls in late summer. The species was observed there in 1947 on 16 August (4 individuals), 3 September (1 immature), 4 September (25), 7 September (200) and 13 September ('many').

On 30 August 1946, 105 Dovekies were observed on the water between Cape Hurd and Cape Ricketts, SW Devon Island; five were seen off SE Cornwallis Island. On 5 September 1946, one was seen near Griffith Island, and on 6 September a total of 17 were seen off Eden Point, SW Devon Island.

The Dovekie was recorded as 'abundant' in Parry Channel as far west as Resolute Bay on 29 August 1947.

Mammals

The Harp Seal was observed 'commonly' in herds of up to 50 individuals at Dundas Harbour in late July and mid-August. At Dundas Harbour, the R.C.M.P. stated that the Bearded Seal arrived in July in 1946; they occur only during the summer.

Walruses were regarded as 'common' in the area; it is stated that 'several were seen in the harbour during July and August'. Eighty Walruses were observed on a beach at the head of Gascoyne Inlet, SW Devon Island, on 29 August 1947. Walruses were noted regularly along the S coast of Cornwallis Island in August; the population of Resolute Bay was about 10 Walruses.

Three species of whales were reported at Dundas Harbour. The R.C.M.P. reportedly observed a Killer Whale catch a Narwhal in September 1945. They also reported that 'many herds [of Beluga] were seen...between September 17 and 28, 1943'; several Narwhals were reported during this same period. Significant numbers of Belugas were reported in some areas in 1947. Two hundred Belugas were observed at Port Leopold, NE Somerset Island, on 1-2 August 1947. A total of 175 individuals were seen off Cape Martyr near Resolute on 7 September 1947.

- F.F. Slaney and Co. Ltd. 1974. Preliminary environmental impact assessment of the proposed Lancaster Sound offshore drilling operations. Unpubl. Rept. to Norlands Petroleum Ltd. 52 pp + appendices.

This report provides a very preliminary review of the potential effects of proposed drilling activities on the bird and marine mammal populations in the Lancaster Sound area. The report is based on a review of some of the relevant literature. Since comprehensive studies of bird and marine mammal distribution in Lancaster Sound and adjacent regions have recently been completed, this study is not summarized here.

- Finley, K.J. and G. Johnston. 1977. An investigation of marine mammals in the vicinity of Somerset Island with emphasis on Bellot Strait, August-September 1976. Unpubl. Rept. by LGL Ltd. to Polar Gas Project. (in prep.).

This study was designed to assess the importance of Bellot Strait as a migration route for migratory marine mammals, particularly Belugas, Narwhals and Harp Seals, from 11 August to 30 September 1976. Unconfirmed reports indicated that Bellot Strait was a major concentration area for marine mammals (C.W.S. 1972); numerous references have documented large concentrations of Belugas in nearby S Peel Sound, N Franklin Strait and S Prince Regent Inlet (Manning and Macpherson 1961; Villiers 1968; Finley *et al.* 1974; Finley 1976). Besides providing the first assessment of the use of Bellot Strait as a migration route, the report gives data on the use of Barrow Strait, Peel Sound and Prince Regent Inlet by marine mammals in late summer and fall. This study complements studies conducted simultaneously in eastern Lancaster Sound by Johnson *et al.* (1976b) and R.R.C.S. (1977).

A migration watch with two observers was conducted at Bellot Strait during the daylight hours (except during adverse weather conditions) daily from 28 August to 24 September. Aerial surveys of both a reconnaissance (at 450 m A.S.L.) and systematic (at 100 m A.S.L.) nature were carried out regularly in Peel Sound, Barrow Strait and along coastal Somerset

Island. All sightings of migratory marine mammals were mapped; large concentrations of Belugas were photographed to provide more accurate estimates of numbers.

Major Findings

Ground observers saw small numbers of Narwhals and Harp Seals in Bellot Strait between 27 August and 4 September; no Belugas were observed. Hence, there was no indication that Bellot Strait was an important migration corridor for marine mammals during the period when migration watches were conducted.

An initial reconnaissance flight in early August established that large numbers of Belugas (at least 3420 individuals) were present in traditional concentrations areas along the N and E coasts of Somerset Island; the largest concentration, 2463 individuals, was in Creswell Bay. Small numbers of Narwhals and Harp Seals were also present in Creswell Bay. Continuous fast-ice in Peel Sound excluded animals from this area until 11 August when the first Belugas were encountered in a new lead along the E coast of Prince of Wales Island.

By late August large numbers of Belugas (2340 individuals) and smaller numbers of Narwhals (900) and Harp Seals (800) had penetrated southward into Peel Sound as far as northern Franklin Strait. A Bowhead whale was also observed in Peel Sound in early September. Belugas were concentrated in Coningham Bay on SE Prince of Wales Island at that time (640+ individuals seen). Similar concentrations were noted there in 1974 as well (Finley *et al.* 1974).

Relatively small numbers of Narwhals (155) were observed in Bellot Strait in late August. Of particular interest was the high proportion of female Narwhals in attendance with neonatal calves (23 such family pairs) that were observed during an aerial survey of Bellot Strait on 4 September.

In early September Belugas were still concentrated in Creswell Bay (2000+ on 4 September); small numbers of Narwhals and Harp Seals were also present. On 5 September, Creswell Bay was vacated by these animals.

On 10 September, there was a large movement of Belugas (1600+ individuals) out of Peel Sound and northward into Barrow Strait. Large numbers of Belugas were encountered near Resolute Bay during the following 10 days; these were thought to represent at least some of the Belugas migrating north out of Peel Sound. Large numbers of Belugas were noted moving eastward along southern Devon Island during the fourth week of September.

Small numbers of Narwhals and Harp Seals were moving northward through Peel Sound until 24 September; by this date new ice had covered large areas in the sound.

During the last aerial survey on 30 September, ice cover was extensive, and the only Harp Seals and Narwhals seen were in small numbers along the S coast of Devon where open water still remained. On this date, West Barrow Strait was essentially covered with new ice and there appeared to be no open water in Peel Sound.

It is suggested that the distribution and movement of the migratory species of marine mammals is controlled by the development of ice break-up which is largely a function of prevailing winds. Belugas, Narwhals and Harp Seals find access through leads which first develop along the eastern and southeastern coasts of Somerset and Prince of Wales Islands and these animals tend to concentrate during the summer because of the protection from ice afforded by the prevailing north and northwesterly winds.

In summary, Narwhals, Belugas and Harp Seals move into Peel Sound via Barrow Strait in late summer when ice conditions permit. The extent of their movement southward in August and September is determined by the amount of ice in S Peel Sound and Franklin Strait. The Belugas were the first to

vacate this area; the movement was completed in early September as the animals moved northward into Barrow Strait. Belugas remained in Barrow Strait until late September; then migrated in large numbers into Lancaster Sound along the S coast of Devon Island. Narwhals and Harp Seals remained in Peel Sound until late September when extensive ice cover had formed; like the Belugas, they retraced their migration route northward to Barrow Strait and then (presumably) eastward into Lancaster Sound.

Observations of birds were also recorded during this study. Large concentrations (several thousands) of seabirds (particularly fulmars and kittiwakes) were observed to concentrate in Creswell Bay from early August to mid-September. A total of 414 Ivory Gulls were counted during one aerial survey over Peel Sound in late September.

● Freuchen, P. and F. Salomonsen. 1958. The arctic year. G.P. Putnam's Sons, New York. 438 pp.

This account consists of a series of essays--one for each month--concerning phenology and events relating to life in the Arctic. The emphasis is on Greenland but the Canadian Arctic, especially the eastern Arctic, is included. Although the book contains much information pertaining to movements of birds and marine mammals, more detailed information is contained in more recent studies relating to individual species or groups of species.

● Gunn, W.W.H. 1949. Report on wildlife observations, arctic weather station re-supply mission, July 15 to September 7, 1949. MS Rept. to Dominion Wildl. Serv., Dept. of Mines and Resources. 58 pp.

This is a series of anecdotal accounts of wildlife observed during the voyage of the arctic re-supply ship in 1949. Some observations were also made during reconnaissance flights from the ship by helicopter. Parts of the present study area that were visited included Barrow Strait, Lancaster Sound and NW Baffin Bay. The observations are brief but some details of observations are given.

Major Findings

Birds

Concentrations of up to 1000 Northern Fulmars were observed along the S coast of Devon Island near Dundas Harbour and Johnson Bay between 14 and 30 August. Other species observed included the Arctic Loon [?], Red-throated Loon, Greater Snow Goose, Oldsquaw, Northern [Common] Eider, eider sp., Gyrfalcon, Rock Ptarmigan, Ringed Plover, Common [Ruddy] Turnstone and [Red] Knot; none of the details of these observations add significantly to more recent data.

Mammals

Seal

Reports from the R.C.M.P. at Dundas Harbour indicated that the Ringed Seal was the commonest seal. Harp Seals were taken frequently at Dundas Harbour during the summer of 1949. The Bearded Seal was also taken regularly in summer.

Walrus

Walruses were reported to be plentiful in 1949. There is a westward migration in spring and an eastward migration in the fall. Gunn reported that a haul-out site was present on a point of land on the W side of Cape Ricketts, SW Devon Island; observations there included 25 Walruses on 17 August and 12 Walruses on 20 August. Gunn indicates that 80 were observed in this area by J.D. Cleghorn in August 1947.

Another haul-out site with 80 Walruses was seen on a beach on the west side of Cape Hurd, E of Radstock Bay, on 20 August. The only other Walruses observed in 1949 were a group of 15 to 20 on ice-pans between Claxton Point (Cornwallis Island) and Griffith Island on 29 August.

Killer Whale

The local Inuit at Dundas Harbour reported that Killer Whales occurred during the summer in Lancaster Sound.

Beluga

Major concentrations observed consisted of 100 to 200 moving NW between Bathurst and Cornwallis Islands on 22 August, and 200 to 300 moving W near Claxton Point, SW Cornwallis Island, on 28 August. R.C.M.P. at Dundas Harbour reported a westward migration in early summer and an eastward migration in the fall.

Narwhal

R.C.M.P. at Dundas Harbour reported that small numbers migrate through Lancaster Sound westward in early summer and eastward in fall.

Fish

Gunn reported large numbers of small fish, almost certainly Arctic Cod, in Barrow Strait: 'While moving through ice in Barrow Strait, it was a common sight to see small fish, presumably sculpins, thrown up onto the churning ice fragments as the ship broke her way through.' [This observation adds additional evidence that Arctic Cod are found near the underside of ice in the area; their occurrence here may be important in explaining the concentrations of seabirds at ice edges.]

- Lawrie, A. 1950. Field report of a biological reconnaissance of the eastern Canadian Arctic Archipelago. July-September 1950. Canad. Wildl. Serv. Unpubl. Rept. 32 pp.

This paper summarizes observations of flora and fauna observed incidentally during the voyages of a supply ship in the Arctic during July-September 1950. Observations were made from aboard ship, during stops at major ports and during aerial reconnaissance flights. Observations are included for Barrow Strait (including Griffith Island and Cornwallis Island) and Lancaster Sound (S coast of Devon Island).

Information that Lawrie gathered from Inuit and from permanent white residents of Resolute Bay and Dundas Harbour is important in establishing the status of several species of marine mammals in the area.

Major Findings

The Ringed Seal is a permanent resident at Dundas Harbour and Croker Bay. The Harp Seal occurs in the open water season at Dundas Harbour from mid-June to mid-October; the species was not known to occur at Resolute Bay. Lawrie noted four herds, each containing about 12 animals, in Radstock Bay, SW Devon Island, on 17 August. The Bearded Seal is a permanent resident in small numbers at Resolute Bay and Dundas Harbour.

The Walrus occurs at Dundas Harbour and Resolute Bay. At Dundas Harbour a migration proceeds westward as soon as the ice goes out; the return migration occurs in late September and early October. Lawrie provides the only indication that Walruses winter in Lancaster Sound (small numbers at Dundas Harbour in 1949-50).

The Inuit at Dundas Harbour were familiar with the Killer Whale but Lawrie never saw the species. The Beluga was said to occur in the thousands during spring and fall migration; they move west at break-up and east at freeze-up. They also were common near Resolute Bay during the summer of 1950. The Narwhal was reportedly seen only occasionally at Dundas Harbour and was not recorded at Resolute Bay. The Bowhead Whale was reportedly seen at Dundas Harbour during the fall of 1949.

● Manning, T.H. and A.H. Macpherson. 1961. A biological investigation of Prince of Wales Island, N.W.T. Trans. Royal Can. Institute 33 (Pt. 2):116-239.

This report included accounts of 35 species of birds and 14 species of mammals that have been recorded on and near Prince of Wales Island; all pertinent background material is reviewed but most of the information presented is based on field work between 26 May and 10 September 1958. The purpose of the trip was primarily to collect birds. The field camp and most intensive field work was conducted near Inner Browne Bay but most parts of the island were visited on foot. These walks form the basis for population estimates for the entire island. These estimates are unreliable

since the logistic support necessary for systematic sampling of this large island was not available. Thus, most of the island could not be visited and habitat and vegetation could not be evaluated.

Major Findings

The most common marine-associated species of birds were King Eider, Long-tailed Jaeger, Oldsquaw, Glaucous Gull, Sabine's Gull, Arctic Tern, Parasitic Jaeger, and Red-throated Loon. Other species were Pomarine Jaeger, Yellow-billed Loon and Arctic Loon.

The marine mammals listed are the Beluga, Narwhal, Bowhead Whale, Polar Bear, Ringed Seal and Bearded Seal. Observations are brief since the emphasis of the study was on birds and mammals in terrestrial situations. They note that Barry (C.W.S. survey) saw 75 Narwhals in S Peel Sound and Franklin Strait. Bowhead Whales were recorded on the basis of bone remains. Barry apparently observed Ringed Seals and Bearded Seals around the island.

● Milton Freeman Research Ltd. 1976. Inuit land use and occupancy project. Prepared for Dept. Indian and Northern Affairs, Ottawa. 3 Vols.

This report was undertaken by the Department of Indian and Northern Affairs following a request from the Inuit Tapirisat of Canada for a comprehensive and verifiable document of Inuit land use and occupancy in the Northwest Territories. The report documents the past and present uses of land and water by Inuit and discusses the resources that they exploit. This remarkable document is a distillation of information based on interviews with over 1600 Inuit hunters and trappers from all parts of the Canadian Arctic.

Major Findings

The communities which hunt or have hunted within the Lancaster Sound study area are Spence Bay, Resolute, Grise Fiord, Arctic Bay, Pond Inlet and Clyde River. Since the Inuit from Spence Bay and Grise Fiord hunt only marginally or irregularly in this area, these are not discussed in the following accounts of natural resource utilization.

Mammals

Beluga

Belugas are not an important resource for Inuit in any of the communities but they are taken wherever possible. [The largest and most consistent kill is at Resolute (Bissett 1967a).]

Narwhal

Narwhals are most important to the Inuit of Pond Inlet and Arctic Bay. Before the advent of snow machines, they provided the food for the dog teams. The tusk and the muktuk are now the most heavily utilized parts of the animal; the meat is not usually eaten. Hunting takes place at floe edges and in ice cracks at break-up, in open water later in the season and rarely in patches of open water in which Narwhals have become trapped during freeze-up. Important areas for floe-edge hunting are the E end of Pond Inlet, the mouth of Buchan Gulf and the E and W sides of the Borden Peninsula.

At Clyde River, Narwhals are most frequently taken during the fall when large numbers occur in shallow fiords and inlets from Home Bay to Scott Inlet. Narwhals were more important during the period 1927-1954 than the period 1954 to 1974. Narwhals are not mentioned as a resource used by Inuit at Resolute. [Bissett 1967a indicates that the species is occasionally taken.]

Polar Bear

Polar Bear hunting is an important activity at all four settlements; quotas are filled rapidly each year. Most bears are now hunted between January and May. Certain areas are heavily hunted. Inuit from Pond Inlet use the area along SE Bylot Island to adjacent N Baffin Island; Arctic Bay hunters use Admiralty Inlet, Lancaster Sound and Prince Regent Inlet; Clyde River inhabitants hunt mainly from Cape Hooper to Buchan Gulf. The Inuit at Resolute hunt over a very large area which includes all of Barrow Strait.

Walrus

Walruses are taken opportunistically at Arctic Bay and Pond Inlet. At

Clyde River Walruses are hunted at favored locations along the Baffin Island coast from Scott Inlet to Alexander Bay. The Inuit at Resolute hunt or have hunted Walrus over a very large area. The nearest haul-out sites in Allen Bay were abandoned in the 1950's; present hunting, usually in conjunction with seal or whale hunting, occurs along N Somerset Island (near Cunningham Inlet), in Penny Strait and along the S coast of Bathurst Island. A decline in the number of Walruses taken at Resolute is attributed to a reduction in the number of sled dogs.

Ringed Seal

Ringed Seals are the prime source of food and certain items of clothing for the Inuit of all settlements and they are taken in virtually all areas.

Bearded Seal

Bearded Seals are hunted in small numbers over the same area that Ringed Seals are hunted. However, there are favored hunting localities at some settlements, particularly the floe-edges off Buchan Gulf, Patterson Inlet and Pond Inlet for Inuit at Pond Inlet, the mouth of Admiralty Inlet for Inuit at Arctic Bay, and in Allen Bay and McDougall Sound for Inuit from Resolute.

Harp Seal

Harp Seal are hunted locally at Resolute Bay [only rarely-Bissett 1967a] and Clyde River (near Cape Christian); few are taken at Pond Inlet, Arctic Bay or Resolute. Because of the short season when they are present in any area, they are of minor importance to the Inuit of the Lancaster Sound area.

Birds

Birds are taken opportunistically and irregularly in most areas. Snow Geese are occasionally hunted during fall migration near Clyde River; the Inuit from Pond Inlet make special journeys to collect Snow Geese on Bylot

Island. Ducks and geese are occasionally hunted (and their eggs are collected) by Inuit from Resolute. Some Thick-billed Murre eggs are collected at Cape Graham Moore, Bylot Island by Inuit from Pond Inlet, and some seabirds are shot, primarily in late spring and summer.

In summary, this study will be of use in determining the economic dependence of Inuit communities in the study area on the natural resources present.

There are, however, some limitations in these data. With few exceptions, the information presented was derived from interviews with Inuit. This has yielded a great deal of useful cultural information; however, no scientific studies have been consulted to determine what natural resources are potentially available. While all known hunting areas are delineated in volume 3 (land use atlas), few quantitative data are presented. Relevant comments are put forth concerning the major or preferred hunting areas, but these are often more an indication of areas where the animals are most easily taken rather than areas where the species are most concentrated. The land-use maps in volume 3 summarize all areas where Inuit have hunted but do not specify where the animals are most actively sought. The base maps which provide this information are not presented in this study; they are on file with the Department of Indian Affairs and Northern Development in Ottawa. The atlas is also of limited use because it fails to differentiate species of seals or whales.

● Nettleship, D.N. and P.A. Smith (ed.). 1975. Ecological sites in northern Canada. Canadian Committee for the International Biological Programme. Conservation Terrestrial--Panel 9. 330 pp.

This volume describes the physical and natural features of 71 biologically important areas in Canada's north. These areas have been identified by members of the Canadian Committee for the International Biological Programme (Conservation Terrestrial - Panel 9) as locations that should be given a high level of consideration for protection, special management or study. The purposes of the report were:

1. to present pertinent information on these areas in a form that may be used by land-use planners and private and public decision makers, and
2. to suggest preliminary guidelines for protection and develop broader guidelines that would indicate potential problems and options available in the selection of alternate areas for northern resource development.

This is the most complete overview of environmentally sensitive areas in the Canadian Arctic. Although deliberately general in its approach, the search for references has been exhaustive and consequently the volume includes the most complete list of references available for each area. However, the information available for each area is variable in reliability and completeness.

Fifteen sites have been identified within the area of concern of this bibliography:

<u>Area</u>	<u>Significance</u>
Washington Point, Baillie Hamilton Island	One of the most northerly Black-legged Kittiwake colonies in the E Canadian Arctic, 3000 pairs; small numbers of Glaucous Gulls and Black Guillemots. [The recurring polynias in the area are important staging areas for eiders in June (Davis <i>et al.</i> 1974).]
Cunningham Inlet, N Somerset Island	An important concentration area for post-calving Belugas during July and August [up to 2000 + individuals have been recorded here (C.W.S. 1972).]; good numbers of Ringed Seals and Polar Bears (some denning activity).

Prince Leopold Island
and adjacent Cape Clarence,
Somerset Island

Unique multi-species community of breeding seabirds including Northern Fulmar, Thick-billed Murre, Glaucous Gull, Black-legged Kittiwake and Black Guillemot. [Estimates are presented in this volume but more recent census data are given by Nettleship and Gaston (1977).]

Bellot Strait

Concentration area for marine mammals (Belugas at W end) and seabirds; Glaucous Gulls [and also many more Thayer's Gulls--Davis *et al.* 1974] nest in the area. [Area used by large numbers of staging eiders in June (Alliston *et al.* 1976) but Beluga concentrations not a regular occurrence (Finley and Johnston 1977).]

Cape Liddon,
Devon Island

A major Northern Fulmar colony of 10,000 pairs [provisionally re-estimated at 5000 pairs (Nettleship and Gaston 1977).]; significant numbers of Black Guillemots and Common Eiders nest near Caswell Tower. Belugas, Harp Seals, Bearded Seals, Ringed Seals and Polar Bears are at times abundant in the area.

Hobhouse Inlet,
Devon Island

A very large Northern Fulmar colony (75,000 to 100,000 breeding pairs); [estimate provisionally revised to about 70,000 birds by Nettleship and Gaston 1977].

Baillarge Bay, NW
Baffin Island

Major Northern Fulmar colony (25,000 + pairs); adjacent to Admiralty Inlet and Lancaster Sound is a critical area for the reproduction and survival of several bird and mammal species including Northern Fulmar,

Baillarge Bay, NW
Baffin Island (cont'd)

Glaucous Gull, Thayer's Gull, Black-legged Kittiwake, Thick-billed Murre, Black Guillemot, Snow Goose, Oldsquaw and eider; also for several mammals including Beluga, Narwhal, Ringed Seal, Walrus and Polar Bear.

Lancaster Sound marine
area, SE Devon Island
(from Cape Home to Cape
Sherard)

This is a major seabird feeding area and an important migration route for marine mammals. The authors suggest that the area may be critical for birds from five fulmar colonies, two murre colonies and two kittiwake colonies [see Nettleship 1974a; Johnson *et al.* 1976a, 1976b; R.R.C.S. 1977; for details of bird and mammal distribution in this area].

Bylot Island

Two major colonies each of Black-legged Kittiwakes (total of about 53,000 pairs) and Thick-billed Murre (total of about 420,000 pairs); a large portion (7500 pairs) of the world's Greater Snow Goose population nests on this island. Also large numbers of Red-throated Loons, Oldsquaws and King Eiders. It is an important area for Polar Bears (denning on E and N coasts and summer sanctuary on NW coast).

Buchan Gulf,
Baffin Island

A colony of at least 25,000 pairs of Northern Fulmars; unknown numbers of breeding Glaucous Gulls.

Scott Inlet,
Baffin Island

A colony of at least 25,000 pairs of Northern Fulmars; unknown numbers of Glaucous Gulls.

Clyde Foreland,
Baffin Island

Biologically rich lowlands along coast; all six species of small passerines nesting on Baffin Island are abundant here.

This volume is an important starting point for any assessment of the potential effects of any future development in the Canadian Arctic. The areas listed, however, should not be regarded as the only scientifically or aesthetically important areas in the north; other areas (e.g., Creswell River lowlands and adjacent Creswell Bay, Somerset Island; Inner Browne Bay and Dolphin River, Prince of Wales Island) may be equally important.

● R. Webb Environmental Services Ltd. 1976. Sea mammal surveys in Baffin Bay and Davis Strait. September 1976. Unpubl. Rept. to Shell Canada Resources Ltd. 34 pp + tables and maps.

This report summarizes the results of aerial surveys to determine the status of seals and whales near two offshore seismic areas in Baffin Bay and Davis Strait. Surveys were conducted between 22 September and 1 October 1976. The specific areas surveyed consisted of two blocks (which 'extend approximately ten miles around' each site) about 30 miles ENE of Cape Hay, Bylot Island, 60 miles ENE of Cape Dyer, Baffin Island. The results of reconnaissance flights between survey blocks, along the coast of Baffin Island, and between Baffin and Bylot Islands are also presented. Only the results of surveys north of Clyde River are discussed here.

Surveys were conducted using a Twin Otter flying at 600 feet ASL; the transects were one mile wide. When weather was adverse or visibility poor the transect width was reduced to one half mile and altitude was maintained at 600 feet or reduced to 300 feet depending on degree of visibility limitation. Surveys were terminated when white caps became numerous.

'Baffin Block' off Bylot Island was surveyed only once, on 24 September (20% coverage). Reconnaissance surveys at 600 feet ASL were completed in Navy Board Inlet, Milne Inlet, Eclipse Sound, Pond Inlet and along the

coastline of Baffin Island from eastern Bylot Island to near Cape Dyer. [Results from these studies cannot be directly compared to the more systematic studies of Johnson *et al.* (1976b) and R.R.C.S. (1977).]

Major Findings

The surveys of the 'Baffin Block' on 24 September yielded sightings of only three seals. Density-indices are presented but no units are specified, the number of miles surveyed is not stated, and the altitude of survey is not specifically noted. Only four birds were noted on the 'Baffin Block' [but surveys at 600 feet ASL (or 300 feet) are too high to produce useful quantitative data.]

An estimated 700 Narwhals were believed to be in the vicinity of Bylot Island (in Navy Board Inlet, Pond Inlet and Eclipse Sound) during reconnaissance surveys in late September; these estimates are based on extrapolations from smaller numbers seen. The largest number actually observed on a single date was 158 on 24 September. The only large numbers of Narwhals observed along the coast of Baffin Island between Pond Inlet and Clyde River were 91 at the mouth of Royal Society Fiord (about 80 miles southeast of Pond Inlet).

No Belugas or Bowhead Whales were observed north of Clyde River. Only two Walruses were observed. A total of 291 Harp Seals were recorded migrating east and south along the coasts of Baffin and Bylot Islands.

No Bearded Seals were identified during the survey. Ringed Seals were numerous but no quantitative information can be derived from the observations. No Polar Bears were observed.

An appended map of observations in Lancaster Sound indicates that concentrations of Beluga Whales occurred along the south coast of Devon Island; single groups of 300 each were seen near Stratton Inlet and Powell Inlet, S Devon Island, on 24 September. [This movement of Belugas was documented and quantified in Johnson *et al.* 1976b and R.R.C.S. 1977].

- Tener, J.S. 1963. Queen Elizabeth Islands game survey, 1961. Canadian Wildlife Service, Occ. Paper No. 4. 50 pp.

Systematic aerial surveys were flown over 18 of the Queen Elizabeth islands (including Devon Island and Cornwallis Island) to determine populations of Peary Caribou and Muskox. Incidental to these surveys were numerous observations of other mammals and birds. The observations of Polar Bears were incorporated into later reports on this species; other observations of birds and mammals do not add to the information contained in more extensive recent studies in these areas.

- Usher, P.J. 1975. Historical statistics approximating fur, fish and game harvests within Inuit lands of the N.W.T. and Yukon 1915-1974, with text. Vol. 3. Inuit Tapirisat of Canada, Renewable Resources Project. 71 pp. + tables.

This volume provides the most complete set of statistics available on the consumptive utilization of wildlife by Inuit. Tables are provided for 30 arctic communities; those of direct interest to this bibliography are Resolute Bay, Arctic Bay, Pond Inlet and Clyde River. Numerous gaps appear in the tables but comments are included regarding the reliability of the figures for each questionable species. Also the holes made for the coil binding have obliterated the data for the 1970's in many of the tables.

Major Results

A general summary of relative harvest levels by species and district is given in Table a. [The information in this table is of little value since there is no explanation of the scaling of relative numbers; the information also appears to be incomplete as of 1975 and inconsistent with known harvest levels (Bissett 1967). For example, the Narwhal catch is given as moderate at Arctic Bay and large at Clyde River. The Narwhal catch in Arctic Bay is large (100+) and consistent from year to year and is probably as large as or larger than the catch at Pond Inlet which is indicated as having a large harvest. The harvest at Clyde River is irregular, though as shown by Usher in the detailed tables of annual catch, up to 54 individuals have been taken in one year (1960-61).

Table a.
Relative Harvest Levels by Species and District

District	Marine Mammals					Birds	
	Polar Bear	Seals	Whales [Belugas?]	Narwhal	Walrus	Ducks	Geese
Arctic Bay	X	-	-	-	-		
Pond Inlet	X	X	-	X	X		
Resolute Bay	X	-	X		X	-	
Clyde River	X	X		X	-		

Large harvest X
Moderate harvest -
Low harvest blank

Note: Blank may occasionally indicate lack of data, and should not be interpreted in all cases as an absolute indication of low harvests.

¹ From Usher (1975)

The harvest of seals (without an indication of which species are taken) is listed as large at Pond Inlet and Clyde River, and moderate at Arctic Bay and Resolute Bay. Large numbers of ringed seals are taken at all four communities since seals still provide a major source of country food for the Inuit. In the case of seals it is likely that the records show far fewer seals than the number actually consumed or utilized locally.

Although Resolute is shown to have a large Walrus harvest, this information is based on the numbers taken in the late 1950's and early 1960's (up to 37 individuals per year). Few have been taken at Resolute in the late 1960's and early 1970's].

● Villiers, D. 1968. The central Arctic : an area economic survey. Area economic survey report 68/1. Dept. Indian Affairs and Northern Development, Industrial Division, Ottawa. 189 pp.

This survey discusses the utilization of and subsequent economic dependence of native people on renewable resources of the central Arctic. The area covered by this volume includes the settlements of Spence Bay, Pelly Bay and Gjoa Haven; the former settlement of Fort Ross, which was inhabited from 1937 to 1946, is also included. The only area of interest to this annotated bibliography in which there is present resource utilization from these communities is Prince Regent Inlet.

Prince Regent Inlet, from Fury Point to Bellot Strait, is used by Inuit of Spence Bay and Pelly Bay as hunting grounds for Polar Bear and Ringed Seal; however, it is not stated what proportion of the kill of each species by each community is taken in Prince Regent Inlet. Belugas and Narwhals also occur in the area but few are taken and their contribution to the economy of the settlements considered is negligible.

POLLUTION

- Bowes, G.W. and C.J. Jonkel. 1975. Presence and distribution of polychlorinated biphenyls (PCB) in Arctic and Subarctic marine food chains. J. Fish. Res. Bd. Canada 32:2111-2123.

This paper is included here since some of the collections were made within our study area (Pond Inlet, Clyde River, Resolute, Lancaster Sound). It is best summarized by the authors' abstract.

'Polychlorinated biphenyls (PCB), man-made industrial chemicals, have been identified in tissues of polar bears (*Ursus maritimus*), ringed (*Phoca hispida*) and square flipper [Bearded] (*Erignathus barbatus*) seals, and Arctic char (*Salvelinus alpinus*) of the Canadian arctic and subarctic. All tissues from each species examined contained these compounds. PCB content in tissue, both absolute and relative to the concentration of DDT (p,p'-DDE + p,p'-DDT), generally increased from seals to adult polar bears to polar bear cubs and young. Polar bear milk contained high concentrations of PCB and is the most probable source of the high concentrations in polar bear cubs. Chromatograms revealed a greater accumulation of higher chlorinated PCB isomers in polar bears than in seals, their main food. Residue data suggest that polar bear subpopulations in the eastern Canadian arctic and subarctic have been exposed to higher levels of PCB and DDT than western subpopulations.'

These findings are of some significance for the following two reasons: (1) they establish background levels of a serious pollutant before truly extensive industrial activity in the north begins, and (2) they indicate that this pollutant is present at least in several levels of the marine food chain. The effects, if any, are presently unknown but if even slight stresses are present they could be seriously magnified by addition of further contaminants such as hydrocarbons.

- Hatfield, C.T. and G.L. Williams. 1976. A summary of possible environmental effects of disposing mine tailings into Strathcona Sound, Baffin Island. North of 60. Dept. of Indian and Northern Affairs. ALUR 75-76-38. 76 pp.

Relevant literature was summarized and interviews with government, university, and industry scientists were conducted in an attempt to determine the fate and possible effects of dumping Strathcona Sound mine tailings into the marine environment.

The following is the authors' conclusion.

'It is concluded that on the basis of present knowledge, mine tailings from the MRI development should not be disposed of in Strathcona Sound. This conclusion is based on the following:

1. Present information on the dynamics of the living environment in the Sound is not adequate.
2. Present data on the physical environment of the Sound, particularly regarding currents, is [*sic*] not sufficient.
3. Scientific knowledge on the long-term effects of zinc, lead, copper and arsenic bioaccumulation on marine life and subsequently on man is uncertain.
4. Cadmium, a constituent of the tailings known to be very harmful to man, would probably be ingested by the local people through contamination of their marine food supply (particularly seal liver) in the area.
5. Alternate methods of tailings disposal appear to be feasible and practical.'

Because of the specific nature of this report, its relevance to other Canadian Arctic areas is somewhat limited. The literature review on the fate of lead, zinc, cadmium, copper and iron in marine environments and the summary of information on northern mines (Greenland and Vancouver Island) presently utilizing marine disposal would have general applicability.

● F.F. Slaney and Co. Ltd. 1974. Preliminary environmental impact assessment of the proposed Lancaster Sound offshore drilling operations. Unpubl. Rept. to Norlands Petroleums Ltd. 49 pp.

This report is a preliminary assessment of the environmental effects of offshore drilling in Lancaster Sound, with emphasis on the potential effects of oil pollution that might result from a blowout. The report is based primarily on the literature and on general principles, although a brief aerial survey for birds and mammals was conducted.

The phytoplankton, marine invertebrate, fish and physical oceanography sections of this report are of a general nature and are sometimes unsubstantiated. In addition, several general statements should be amended.

The report states that 'The main productivity of Arctic seas occurs in open, ice-free waters. [Insufficient information about the relative contributions to total productivity from benthic algae, ice algae, under-ice phytoplankton, and open water phytoplankton is available to substantiate this statement. The works of Apollonio in the early 1960's in the Canadian Arctic and that of Horner and Alexander in 1972 in Alaska and others have documented that the ice diatom community contributes significant amounts to production in the spring. The more recent work of Apollonio in Jones Sound (see Apollonio 1976a,b) supports a view that the main productivity, at least in some portions of the Canadian Archipelago, occurs in the under-ice phytoplankton community before the ice breaks up.]

The statement that Arctic phytoplankton populations are composed predominantly of centric diatoms is not strictly true. It has been well documented by the work of Bursa in 1960's and others that early in the season pennate diatoms dominate the phytoplankton.

The brief discussion of the physical oceanography of Lancaster Sound is somewhat confusing and contradictory to the findings of oceanographic researchers. The net mass transport of water to the west at the longitude of Dundas Harbour is contrary to the results and/or deductions of all oceanographic work concerning Lancaster Sound and Baffin Bay (see Kiilerich 1939; Dunbar 1951; Bailey 1957; Collin 1962; Muench 1971). This statement is indirectly contradicted in a following section by the statement that mass transport is to the east in eastern Lancaster Sound. Two additional assumptions contained in the work ('expected lack of currents in the bottom region' and 'in the eastern part of Lancaster Sound, the direction of ocean currents depends to a great extent on the prevailing wind') require clarification.

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